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(54) Title: HYDROXY DIPHENYL UREA SULFONAMIDES AS IL-8 RECEPTOR ANTAGONISTS

(57) Abstract

The invention relates to novel hydroxy diphenylurea sulfonamides, compositions and intermediates thereof. The hydroxy diphenylurea sulfonamides are useful in the treatment of disease states mediated by the chemokine, Interleukin-8.

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HYDROXY DIPHENYL UREA SULFONAMIDES AS IL-8 RECEPTOR ANTAGONISTS

FIELD OF THE INVENTION

This invention relates to novel sulfonamide substituted diphenyl urea compounds, pharmaceutical compositions, processes for their preparation, and use thereof in treating IL-8, GROα, GROβ, GROγ, NAP-2, and ENA-78 mediated diseases.

BACKGROUND OF THE INVENTION

Many different names have been applied to Interleukin-8 (IL-8), such as neutrophil attractant/activation protein-1 (NAP-1), monocyte derived neutrophil chemotactic factor (MDNCF), neutrophil activating factor (NAF), and T-cell lymphocyte chemotactic factor. Interleukin-8 is a chemoattractant for neutrophils, basophils, and a subset of T-cells. It is produced by a majority of nucleated cells including macrophages, fibroblasts, endothelial and epithelial cells exposed to TNF, IL-1α, IL-1β or LPS, and by neutrophils themselves when exposed to LPS or chemotactic factors such as FMLP. M. Baggiolini et al., J. Clin. Invest. *84*, 1045 (1989); J. Schroder et al, J. Immunol. *139*, 3474 (1987) and J. Immunol. *144*, 2223 (1990) ; Strieter, et al., Science *243*, 1467 (1989) and J. Biol. Chem. *264*, 10621 (1989); Cassatella et al., J. Immunol. *148*, 3216 (1992).

GROα, GROβ, GROγ and NAP-2 also belong to the chemokine family. Like IL-8 these chemokines have also been referred to by different names. For instance GROα, β, γ have been referred to as MGSAα, β and γ respectively (Melanoma Growth Stimulating Activity), see Richmond et al., J. Cell Physiology 129, 375 (1986) and Chang et al., J. Immunol 148, 451 (1992). All of the chemokines of the α-family which possess the ELR motif directly preceding the CXC motif bind to the IL-8 B receptor (CXCR2).

IL-8, GROα, GROβ, GROγ, NAP-2, and ENA-78 stimulate a number of functions in vitro. They have all been shown to have chemoattractant properties for neutrophils, while IL-8 and GROα have demonstrated T-lymphocytes, and basophilic chemotactic activity. In addition IL-8 can induce histamine release from basophils from both normal and atopic individuals. GRO-α and IL-8 can in addition, induce lysozomal enzyme release and respiratory burst from neutrophils. IL-8 has also been shown to increase the surface expression of Mac-1 (CD11b/CD18) on neutrophils without de novo protein synthesis. This may contribute to increased adhesion of the neutrophils to vascular endothelial cells. Many known diseases are characterized by massive neutrophil infiltration. As IL-8, GROα, GROβ, GROγ and NAP-2 promote the accumulation and activation of neutrophils, these chemokines have been implicated in a wide range of acute and chronic inflammatory disorders including psoriasis and rheumatoid arthritis, Baggiolini et al., FEBS Lett. *307*, 97 (1992); Miller et al., Crit. Rev. Immunol. *12*, 17 (1992); Oppenheim et al., Annu. Rev. Immunol. *9*, 617 (1991); Seitz et al., J. Clin. Invest. *87*, 463 (1991); Miller et al., Am. Rev.

Respir. Dis. *146*, 427 (1992); Donnely et al., Lancet *341*, 643 (1993). In addition the ELR chemokines (those containing the amino acids ELR motif just prior to the CXC motif) have also been implicated in angiostasis, Strieter et al., Science 258, 1798 (1992).

In vitro, IL-8, GROα, GROβ, GROγ and NAP-2 induce neutrophil shape change, chemotaxis, granule release, and respiratory burst, by binding to and activating receptors of the seven-transmembrane, G-protein-linked family, in particular by binding to IL-8 receptors, most notably the IL-8β receptor (CXCR2). Thomas et al., J. Biol. Chem. *266*, 14839 (1991); and Holmes et al., Science *253*, 1278 (1991). The development of non-peptide small molecule antagonists for members of this receptor family has precedent. For a review see R. Freidinger in: Progress in Drug Research, Vol. 40, pp. 33-98, Birkhauser Verlag, Basel 1993. Hence, the IL-8 receptor represents a promising target for the development of novel anti-inflammatory agents.

Two high affinity human IL-8 receptors (77% homology) have been characterized: IL-8Rα, which binds only IL-8 with high affinity, and IL-8Rβ, which has high affinity for IL-8 as well as for GROα, GROβ, GROγ and NAP-2. See Holmes et al., supra; Murphy et al., Science *253*, 1280 (1991); Lee et al., J. Biol. Chem. *267*, 16283 (1992); LaRosa et al., J. Biol. Chem. *267*, 25402 (1992); and Gayle et al., J. Biol. Chem. *268*, 7283 (1993).

There remains a need for treatment, in this field, for compounds, which are capable of binding to the IL-8 α or β receptor. Therefore, conditions associated with an increase in IL-8 production (which is responsible for chemotaxis of neutrophil and T-cells subsets into the inflammatory site) would benefit by compounds, which are inhibitors of IL-8 receptor binding.

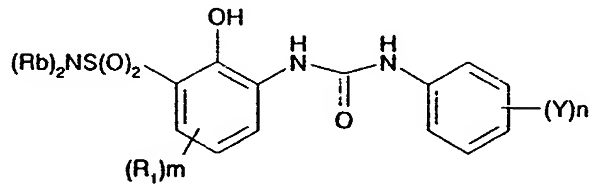
SUMMARY OF THE INVENTION

This invention provides for a method of treating a chemokine mediated disease, wherein the chemokine is one which binds to an IL-8 a or b receptor and which method comprises administering an effective amount of a compound of Formula (I) or a pharmaceutically acceptable salt thereof. In particular the chemokine is IL-8.

This invention also relates to a method of inhibiting the binding of IL-8 to its receptors in a mammal in need thereof which comprises administering to said mammal an effective amount of a compound of Formula (I).

The present invention also provides for the novel compounds of Formula (I), and pharmaceutical compositions comprising a compound of Formula (I), and a pharmaceutical carrier or diluent.

Compounds of Formula (I) useful in the present invention are represented by the structure:



(I)

wherein

R_b is independently hydrogen, NR_6R_7, OH, OR_a, C_{1-5}alkyl, aryl, arylC_{1-4}alkyl, aryl C_{2-4}alkenyl; cycloalkyl, cycloalkyl C_{1-5} alkyl, heteroaryl, heteroarylC_{1-4}alkyl, heteroarylC_{2-4} alkenyl, heterocyclic, heterocyclic C_{1-4}alkyl, or a heterocyclic C_{2-4}alkenyl moiety, all of which moieties may be optionally substituted one to three times independently by halogen; nitro; halosubstituted C_{1-4} alkyl; C_{1-4} alkyl; amino, mono or di-C_{1-4} alkyl substituted amine; OR_a; $C(O)R_a$; $NR_aC(O)OR_a$; $OC(O)NR_6R_7$; hydroxy; $NR_9C(O)R_a$; $S(O)_{m'}R_a$; $C(O)NR_6R_7$; C(O)OH; $C(O)OR_a$; $S(O)_tNR_6R_7$; $NHS(O)_tR_a$. Alternatively, the two R_b substituents can join to form a 3-10 membered ring, optionally substituted and containing, in addition to optionally substituted C_{1-4} alkyl, independently, 1 to 3 NR_a, O, S, SO, or SO_2 moities which can be optionally unsaturated;

R_a is an alkyl, aryl, arylC_{1-4}alkyl, heteroaryl, heteroaryl C_{1-4}alkyl, heterocyclic, $COOR_a'$, or a heterocyclic C_{1-4}alkyl moiety, all of which moieties may be optionally substituted;

R_a' is an alkyl, aryl, arylC_{1-4}alkyl, heteroaryl, heteroaryl C_{1-4}alkyl, heterocyclic or a heterocyclic C_{1-4}alkyl moiety, all of which moieties may be optionally substituted;

m is an integer having a value of 1 to 3;

m' is 0, or an integer having a value of 1 or 2;

n is an integer having a value of 1 to 3;

q is 0, or an integer having a value of 1 to 10;

t is 0, or an integer having a value of 1 or 2;

s is an integer having a value of 1 to 3;

R_1 is independently selected from hydrogen, halogen, nitro, cyano, C_{1-10} alkyl, halosubstituted C_{1-10} alkyl, C_{2-10} alkenyl, C_{1-10} alkoxy, halosubstituted C_{1-10}alkoxy, azide, $S(O)_tR_4$, $(CR_8R_8)q$ $S(O)_tR_4$, hydroxy, hydroxy substituted C_{1-4}alkyl, aryl, aryl C_{1-4} alkyl, aryl C_{2-10} alkenyl, aryloxy, aryl C_{1-4} alkyloxy, heteroaryl, heteroarylalkyl, heteroaryl C_{2-10} alkenyl, heteroaryl C_{1-4} alkyloxy, heterocyclic, heterocyclic C_{1-4}alkyl, heterocyclicC_{1-4}alkyloxy, heterocyclicC_{2-10} alkenyl, $(CR_8R_8)q$ NR_4R_5, $(CR_8R_8)qC(O)NR_4R_5$, C_{2-10} alkenyl $C(O)NR_4R_5$, $(CR_8R_8)q$ $C(O)NR_4R_{10}$, $S(O)_3R_8$, $(CR_8R_8)q$ $C(O)R_{11}$, C_{2-10} alkenyl $C(O)R_{11}$, C_{2-10} alkenyl $C(O)OR_{11}$, $(CR_8R_8)q$ $C(O)OR_{11}$, $(CR_8R_8)q$ $OC(O)R_{11}$, $(CR_8R_8)qNR_4C(O)R_{11}$, $(CR_8R_8)q$ $C(NR_4)NR_4R_5$, $(CR_8R_8)q$ $NR_4C(NR_5)R_{11}$, $(CR_8R_8)q$

$NHS(O)_tR_{13}$, $(CR_8R_8)q\ S(O)_tNR_4R_5$, or two R_1 moieties together may form $O-(CH_2)_sO$ or a 5 to 6 membered saturated or unsaturated ring, and wherein the alkyl, aryl, arylalkyl, heteroaryl, heterocyclic moieties may be optionally substituted;

R_4 and R_5 are independently hydrogen, optionally substituted C_{1-4} alkyl, optionally substituted aryl, optionally substituted aryl C_{1-4}alkyl, optionally substituted heteroaryl, optionally substituted heteroaryl C_{1-4}alkyl, heterocyclic, heterocyclicC_{1-4} alkyl, or R_4 and R_5 together with the nitrogen to which they are attached form a 5 to 7 member ring which may optionally comprise an additional heteroatom selected from O, N and S;

R_6 and R_7 are independently hydrogen, or a C_{1-4} alkyl, heteroaryl, aryl, aklyl aryl, alkyl C_{1-4} heteroalkyl, which may all be optionally substituted or R_6 and R_7 together with the nitrogen to which they are attached form a 5 to 7 member ring which ring may optionally contain an additional heteroatom is selected from oxygen, nitrogen or sulfur, and which ring may be optionally substituted;

Y is hydrogen, halogen, nitro, cyano, halosubstituted C_{1-10} alkyl, C_{1-10} alkyl, C_{2-10} alkenyl, C_{1-10} alkoxy, halosubstituted C_{1-10} alkoxy, azide, $(CR_8R_8)qS(O)_tR_a$, $(CR_8R_8)qOR_a$, hydroxy, hydroxy substituted C_{1-4}alkyl, aryl; aryl C_{1-4} alkyl, aryloxy, arylC_{1-4} alkyloxy, aryl C_{2-10} alkenyl, heteroaryl, heteroarylalkyl, heteroaryl C_{1-4} alkyloxy, heteroaryl C_{2-10} alkenyl, heterocyclic, heterocyclic C_{1-4}alkyl, heterocyclicC_{2-10} alkenyl, $(CR_8R_8)qNR_4R_5$, C_{2-10} alkenyl $C(O)NR_4R_5$, $(CR_8R_8)qC(O)NR_4R_5$, $(CR_8R_8)q\ C(O)NR_4R_{10}$, $S(O)_3R_8$, $(CR_8R_8)qC(O)R_{11}$, C_{2-10} alkenyl$C(O)R_{11}$, $(CR_8R_8)qC(O)OR_{11}$, C_{2-10}alkenyl$C(O)OR_{11}$, $(CR_8R_8)qOC(O)R_{11}$, $(CR_8R_8)qNR_4C(O)R_{11}$, $(CR_8R_8)q\ NHS(O)_tR_{13}$, $(CR_8R_8)q\ S(O)_tNR_4R_5$, $(CR_8R_8)qC(NR_4)NR_4R_5$, $(CR_8R_8)q\ NR_4C(NR_5)R_{11}$, or two Y moieties together may form $O-(CH_2)_s-O$ or a 5 to 6 membered saturated or unsaturated ring, and wherein the alkyl, aryl, arylalkyl, heteroaryl, heteroaryl alkyl, heterocyclic, heterocyclicalkyl groups may be optionally substituted;

R_8 is hydrogen or C_{1-4} alkyl;

R_9 is hydrogen or a C_{1-4} alkyl;

R_{10} is C_{1-10} alkyl $C(O)_2R_8$;

R_{11} is hydrogen, optionally substituted C_{1-4} alkyl, optionally substituted aryl, optionally substituted aryl C_{1-4}alkyl, optionally substituted heteroaryl, optionally substituted heteroarylC_{1-4}alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclicC_{1-4}alkyl;

R_{13} is suitably C_{1-4} alkyl, aryl, aryl C_{1-4}alkyl, heteroaryl, heteroarylC_{1-4}alkyl, heterocyclic, or heterocyclicC_{1-4}alkyl;

or a pharmaceutically acceptable salt thereof.

DETAILED DESCRIPTION OF THE INVENTION

The compounds of Formula (I), may also be used in association with the veterinary treatment of mammals, other than humans, in need of inhibition of IL-8 or other chemokines which bind to the IL-8 α and β receptors. Chemokine mediated diseases for treatment, therapeutically or prophylactically, in animals include disease states such as those noted herein in the Methods of Treatment section.

Suitably, R_b is independently hydrogen, NR_6R_7, OH, OR_a, C_{1-4}alkyl, aryl, arylC_{1-4}alkyl, aryl C_{2-4}alkenyl, heteroaryl, heteroarylC_{1-4}alkyl, heteroarylC_{2-4} alkenyl, heterocyclic, heterocyclic C_{1-4}alkyl, or a heterocyclic C_{2-4}alkenyl moiety, all of which moieties may be optionally substituted one to three times independently by halogen, nitro, halosubstituted C_{1-4} alkyl, C_{1-4} alkyl, amino, mono or di-C_{1-4} alkyl substituted amine, cycloalkyl, cycloalkyl C_{1-5} alkyl, OR_a, $C(O)R_a$, $NR_aC(O)OR_a$, $OC(O)NR_6R_7$, aryloxy, aryl C_{1-4} oxy, hydroxy, C_{1-4} alkoxy, $NR_9C(O)R_a$, $S(O)_{m'}R_a$, $C(O)NR_6R_7$, $C(O)OH$, $C(O)OR_a$, $S(O)_tNR_6R_7$, $NHS(O)_tR_a$. Alternatively, the two R_b substituents can join to form a 3-10 membered ring, optionally substituted and containing, in addition to carbon, independently, 1 to 3 NR_9, O, S, SO, or SO_2 moities which can be optionally substituted.

Suitably, R_a is an alkyl, aryl, arylC_{1-4}alkyl, heteroaryl, heteroaryl C_{1-4}alkyl, heterocyclic, or a heterocyclic C_{1-4}alkyl moiety, all of which moieties may be optionally substituted.

Suitably, R_1 is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C_{1-10} alkyl, such as CF_3, C_{1-10} alkyl, such as methyl, ethyl, isopropyl, or n-propyl, C_{2-10} alkenyl, C_{1-10} alkoxy, such as methoxy, or ethoxy; halosubstituted C_{1-10} alkoxy, such as trifluoromethoxy, azide, $(CR_8R_8)_q\ S(O)_tR_4$, wherein t is 0, 1 or 2, hydroxy, hydroxy C_{1-4}alkyl, such as methanol or ethanol, aryl, such as phenyl or naphthyl, aryl C_{1-4} alkyl, such as benzyl, aryloxy, such as phenoxy, aryl C_{1-4} alkyloxy, such as benzyloxy; heteroaryl, heteroarylalkyl, heteroaryl C_{1-4} alkyloxy; aryl C_{2-10} alkenyl, heteroaryl C_{2-10} alkenyl, heterocyclic C_{2-10} alkenyl, $(CR_8R_8)_qNR_4R_5$, C_{2-10} alkenyl $C(O)NR_4R_5$, $(CR_8R_8)_qC(O)NR_4R_5$, $(CR_8R_8)_qC(O)NR_4R_{10}$, $S(O)_3H$, $S(O)_3R_8$, $(CR_8R_8)_qC(O)R_{11}$, C_{2-10} alkenyl $C(O)R_{11}$, C_{2-10} alkenyl $C(O)OR_{11}$, $(CR_8R_8)_q\ C(O)R_{11}$, $(CR_8R_8)_qC(O)OR_{11}$, $(CR_8R_8)_q\ OC(O)R_{11}$, $(CR_8R_8)_qNR_4C(O)R_{11}$, $(CR_8R_8)_qC(NR_4)NR_4R_5$, $(CR_8R_8)_q\ NR_4C(NR_5)R_{11}$, $(CR_8R_8)_qNHS(O)_tR_{13}$, $(CR_8R_8)_qS(O)_tNR_4R_5$. All of the aryl, heteroaryl, and heterocyclic-containing moieties may be optionally substituted as defined herein below.

For use herein the term "the aryl, heteroaryl, and heterocyclic containing moieties" refers to both the ring and the alkyl, or if included, the alkenyl rings, such as aryl, arylalkyl, and aryl alkenyl rings. The term "moieties" and "rings" may be interchangeably used throughout.

Suitably, R_4 and R_5 are independently hydrogen, optionally substituted C_{1-4} alkyl, optionally substituted aryl, optionally substituted aryl C_{1-4}alkyl, optionally substituted heteroaryl, optionally substituted heteroaryl C_{1-4}alkyl, heterocyclic, heterocyclicC_{1-4} alkyl, or R_4 and R_5 together with the nitrogen to which they are attached form a 5 to 7 member ring which may optionally comprise an additional heteroatom selected from O, N and S.

Suitably, R_8 is independently hydrogen or C_{1-4} alkyl.

Suitably, R_9 is hydrogen or a C_{1-4} alkyl;

Suitably, q is 0 or an integer having a value of 1 to 10.

Suitably, R_{10} is C_{1-10} alkyl $C(O)_2R_8$, such as $CH_2C(O)_2H$ or $CH_2C(O)_2CH_3$.

Suitably, R_{11} is hydrogen, C_{1-4} alkyl, aryl, aryl C_{1-4} alkyl, heteroaryl, heteroaryl C_{1-4}alkyl, heterocyclic, or heterocyclic C_{1-4}alkyl.

Suitably, R_{12} is hydrogen, C_{1-10} alkyl, optionally substituted aryl or optionally substituted arylalkyl.

Suitably, R_{13} is C_{1-4}alkyl, aryl, arylalkyl, heteroaryl, heteroarylC_{1-4}alkyl, heterocyclic, or heterocyclicC_{1-4}alkyl, wherein all of the aryl, heteroaryl and heterocyclic containing moieties may all be optionally substituted.

Suitably, Y is independently selected from hydrogen; halogen; nitro; cyano; halosubstituted C_{1-10} alkyl; C_{1-10} alkyl; C_{2-10} alkenyl; C_{1-10} alkoxy; halosubstituted C_{1-10} alkoxy; azide; $(CR_8R_8)q$ $S(O)_tR_a$; hydroxy; hydroxyC_{1-4}alkyl; aryl; aryl C_{1-4} alkyl; aryloxy; arylC_{1-4} alkyloxy; heteroaryl; heteroarylalkyl; heteroaryl C_{1-4} alkyloxy; heterocyclic, heterocyclic C_{1-4}alkyl; aryl C_{2-10} alkenyl; heteroaryl C_{2-10} alkenyl; heterocyclic C_{2-10} alkenyl; $(CR_8R_8)q$ NR_4R_5; C_{2-10} alkenyl $C(O)NR_4R_5$; $(CR_8R_8)q$ $C(O)NR_4R_5$; $(CR_8R_8)q$ $C(O)NR_4R_{10}$; $S(O)_3H$; $S(O)_3R_8$; $(CR_8R_8)q$ $C(O)R_{11}$; C_{2-10} alkenyl $C(O)R_{11}$; C_{2-10} alkenyl $C(O)OR_{11}$; $(CR_8R_8)q$ $C(O)OR_{12}$; $(CR_8R_8)q$ $OC(O)R_{11}$; $(CR_8R_8)qC(NR_4)NR_4R_5$; $(CR_8R_8)q$ $NR_4C(NR_5)R_{11}$; $(CR_8R_8)q$ $NR_4C(O)R_{11}$; $(CR_8R_8)q$ $NHS(O)_tR_{13}$; or $(CR_8R_8)q$ $S(O)_tNR_4R_5$; or two Y moieties together may form $O\text{-}(CH_2)_s\text{-}O$ or a 5 to 6 membered saturated or unsaturated ring. The aryl, heteroaryl and heterocyclic containing moieties noted above may all be optionally substituted as defined herein.

Suitably s is an integer having a value of 1 to 3.

When Y forms a dioxybridge, s is preferably 1. When Y forms an additional unsaturated ring, it is preferably 6 membered resulting in a naphthylene ring system. These ring systems may be substituted 1 to 3 times by other Y moieties as defined above.

Suitably, R_a is an alkyl, aryl C_{1-4} alkyl, heteroaryl, heteroaryl-C_{1-4}alkyl, heterocyclic, or a heterocyclicC_{1-4} alkyl, wherein all of these moieties may all be optionally substituted.

Y is preferably a halogen, C_{1-4} alkoxy, optionally substituted aryl, optionally substituted aryloxy or arylalkoxy, methylene dioxy, NR_4R_5, thio C_{1-4}alkyl, thioaryl, halosubstituted alkoxy, optionally substituted C_{1-4} alkyl, or hydroxy alkyl. Y is more preferably mono-substituted halogen, disubstituted halogen, mono-substituted alkoxy, disubstituted alkoxy, methylenedioxy, aryl, or alkyl, more preferably these groups are mono or di-substituted in the 2'- position or 2'-, 3'-position.

While Y may be substituted in any of the ring positions, n is preferably one. While both R_1 and Y can both be hydrogen, it is preferred that at least one of the rings is substituted, preferably both rings are substituted.

As used herein, "optionally substituted" unless specifically defined shall mean such groups as halogen, such as fluorine, chlorine, bromine or iodine, hydroxy; hydroxy substituted C_{1-10}alkyl, C_{1-10} alkoxy, such as methoxy or ethoxy, $S(O)_{m'}C_{1-10}$ alkyl, wherein m' is 0, 1 or 2, such as methyl thio, methyl sulfinyl or methyl sulfonyl; amino, mono & di-substituted amino, such as in the NR_4R_5 group, $NHC(O)R_4$, $C(O)NR_4R_5$, $COOR_4$, $S(O)_tNR_4R_5$, $NHS(O)_tR_{20}$, C_{1-10} alkyl, such as methyl, ethyl, propyl, isopropyl, or t-butyl, halosubstituted C_{1-10} alkyl, such CF_3, an optionally substituted aryl, such as phenyl, or an optionally substituted arylalkyl, such as benzyl or phenethyl, optionally substituted heterocylic, optionally substituted heterocyclicalkyl, optionally substituted heteroaryl, optionally substituted heteroaryl alkyl, wherein these aryl, heteroaryl, or heterocyclic moieties may be substituted one to two times by halogen; hydroxy; hydroxy substituted alkyl, C_{1-10} alkoxy; $S(O)_mC_{1-10}$ alkyl; amino, mono & di-substituted alkyl amino, such as in the NR_4R_5 group; C_{1-10} alkyl, or halosubstituted C_{1-10} alkyl, such as CF_3.

R_{20} is suitably C_{1-4} alkyl, aryl, aryl C_{1-4}alkyl, heteroaryl, heteroarylC_{1-4}alkyl, heterocyclic, or heterocyclicC_{1-4}alkyl.

Suitable pharmaceutically acceptable salts are well known to those skilled in the art and include basic salts of inorganic and organic acids, such as hydrochloric acid, hydrobromic acid, sulphuric acid, phosphoric acid, methane sulphonic acid, ethane sulphonic acid, acetic acid, malic acid, tartaric acid, citric acid, lactic acid, oxalic acid, succinic acid, fumaric acid, maleic acid, benzoic acid, salicylic acid, phenylacetic acid and mandelic acid. In addition, pharmaceutically acceptable salts of compounds of Formula (I) may also be formed with a pharmaceutically acceptable cation. Suitable pharmaceutically acceptable cations are well known to those skilled in the art and include alkaline, alkaline earth, ammonium and quaternary ammonium cations.

The following terms, as used herein, refer to:

- "halo" - all halogens, that is chloro, fluoro, bromo and iodo.

• "C_{1-10}alkyl" or "alkyl" - both straight and branched chain moieties of 1 to 10 carbon atoms, unless the chain length is otherwise limited, including, but not limited to, methyl, ethyl, *n*-propyl, *iso*-propyl, *n*-butyl, *sec*-butyl, *iso*-butyl, *tert*-butyl, *n*-pentyl and the like.

• "cycloalkyl" is used herein to mean cyclic moiety, preferably of 3 to 8 carbons, including but not limited to cyclopropyl, cyclopentyl, cyclohexyl, and the like.

• "alkenyl" is used herein at all occurrences to mean straight or branched chain moiety of 2-10 carbon atoms, unless the chain length is limited thereto, including, but not limited to ethenyl, 1-propenyl, 2-propenyl, 2-methyl-1-propenyl, 1-butenyl, 2-butenyl and the like.

• "aryl" - phenyl and naphthyl;

• "heteroaryl" (on its own or in any combination, such as "heteroaryloxy", or "heteroaryl alkyl") - a 5-10 membered aromatic ring system in which one or more rings contain one or more heteroatoms selected from the group consisting of N, O or S, such as, but not limited, to pyrrole, pyrazole, furan, thiophene, quinoline, isoquinoline, quinazolinyl, pyridine, pyrimidine, oxazole, tetrazole, thiazole, thiadiazole, triazole, imidazole, or benzimidazole.

• "heterocyclic" (on its own or in any combination, such as "heterocyclicalkyl") - a saturated or partially unsaturated 4-10 membered ring system in which one or more rings contain one or more heteroatoms selected from the group consisting of N, O, or S; such as, but not limited to, pyrrolidine, piperidine, piperazine, morpholine, tetrahydropyran, thiomorpholine, or imidazolidine. Furthermore, sulfur may be optionally oxidized to the sulfone or the sulfoxide.

• "arylalkyl" or "heteroarylalkyl" or "heterocyclicalkyl" is used herein to mean C_{1-10} alkyl, as defined above, attached to an aryl, heteroaryl or heterocyclic moiety, as also defined herein, unless otherwise indicated.

• "sulfinyl" - the oxide S (O) of the corresponding sulfide, the term "thio" refers to the sulfide, and the term "sulfonyl" refers to the fully oxidized $S(O)_2$ moiety.

• "wherein two R_1 moieties (or two Y moieties) may together form a 5 or 6 membered saturated or unsaturated ring" is used herein to mean the formation of an aromatic ring system, such as naphthalene, or is a phenyl moiety having attached a 6 membered partially saturated or unsaturated ring such as a C_6 cycloalkenyl, i.e. hexene, or a C_5 cycloalkenyl moiety, such as cyclopentene.

Illustrative compounds of Formula (I) include:

N-(2-Hydroxyl-3-aminosulfonyl-4-chlorophenyl)-N'-(2-bromophenyl) urea;
N-(2-Hydroxy-3-aminosulfonyl-4-chlorophenyl)-N'-(2,3-dichlorophenyl) urea;
N-(2-Hydroxy-3-N"-benzylaminosulfonyl-4-chlorophenyl)-N'-(2-bromophenyl) urea;

N-(2-Hydroxy-3-N"-benzylaminosulfonyl-4-chlorophenyl)-N'-(2,3-dichlorophenyl) urea;
N-[2-Hydroxy-3-(N",N"-dimethyl)-aminosulfonyl-4-chlorophenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-Hydroxy-3-N",N"-dimethylaminosulfonyl-4-chlorophenyl)-N'-(2-bromophenyl) urea;
N-(2-Hydroxy-3-N"-methylaminosulfonyl-4-chlorophenyl)-N'-(2-bromophenyl) urea;
N-(2-Hydroxy-3-N"-methylaminosulfonyl-4-chlorophenyl)-N'-(2,3-dichlorophenyl) urea;
N-[2-Hydroxy-3-[N-(methoxycarbonylmethyl)aminosulfonyl]-4-chlorophenyl]-N'-(2,3-dichlorophenyl) urea;
N-[2-Hydroxy-3-(N"-(2-methoxylcarbonyl)-methyl)-aminosulfonyl-4-chlorophenyl]-N'-(2-bromophenyl) urea;
N-[2-Hydroxy-3-[(N"-2-carboxymethyl)-aminosulfonyl]-4-chlorophenyl]-N'-(2,3-dichlorophenyl) urea;
N-[2-Hydroxy-3-(N"-2-carboxymethyl)-aminosulfonyl-4-chlorophenyl]-N'-(2-bromophenyl) urea;
N-[2-Hydroxy-3-aminosulfonyl-4-chlorophenyl]-N'-(2-chlorophenyl) urea;
N-[2-Hydroxy-3-aminosulfonyl-4-chlorophenyl]-N'-phenyl urea;
N-(2-Hydroxy-3-aminosulfonyl-4-chlorophenyl)-N'-(2-phenoxyphenyl) urea;
N-(2-Hydroxy-3-[N"-(3-carboxyethyl)-aminosulfonyl]-4-chlorophenyl)-N'-(2-bromophenyl) urea;
N-[2-Hydroxy-3-(isopropylaminosulfonyl)-4-chlorophenyl]-N'-(2-bromophenyl) urea;
N-[2-Hydroxy-3-(isopropylaminosulfonyl)-4-chlorophenyl]-N'-(2-chlorophenyl) urea;
N-[2-Hydroxy-3-(isopropylaminosulfonyl)-4-chlorophenyl]-N'-(2,3-dichlorophenyl) urea;
N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2-methoxyphenyl) urea;
N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-methylenedioxy phenyl) urea;
N-(2-benzyloxyphenyl)-N'-(4-chloro-2-hydroxy-3-aminosulfonylphenyl) urea;
N-[3-(N"-allylaminosulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;
N-[4-chloro-2-hydroxy-3-[N"-(2-trifluoroethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2,3-dichlorophenyl)-N'-[2-hydroxy-4-methoxy-3-N"-(phenylaminosulfonyl)phenyl] urea;
N-(2-bromophenyl)-N'-[2-hydroxy-4-methoxy-3-N"-(phenylaminosulfonyl)phenyl] urea;
N-[4-chloro-2-hydroxy-3-[N"-(2-methoxyethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(2-methoxyethyl)aminosulfonyl]phenyl] urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(4-morpholinylsulfonyl)phenyl] urea;

N-[4-chloro-2-hydroxy-3-(4-morpholinylsulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea;
N-[3-[N"-[3-(tert-butoxycarbonylamino)propyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[3-[N"-[3-(tert-butoxycarbonylamino)propyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea;
N-[3-[N"-(3-aminopropyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea trifluoroacetate;
N-[3-[N"-(3-aminopropyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea hydrochloride;
N-[3-[N"-(3-aminopropyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate;
N-(2-bromophenyl)-N'-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea;
N-[3-[N"-(2-aminoethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea;
N-(2-bromophenyl)-N'-[3-[[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl]-4-chloro-2-hydroxyphenyl] urea;
N-[3-[[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;
N-[4-chloro-2-hydroxy-3-(1-piperazinylsulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(piperazin-1-ylsulfonyl)phenyl] urea trifluoroacetate;
N-[4-chloro-2-hydroxy-3-[N"-(3-methylthiopropyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(3-methylthiopropyl)aminosulfonyl]phenyl] urea;
N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea potasium salt;
N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea sodium salt;
N-(2-bromophenyl)-N'-[4-chloro-3-[N",N"-di-(2-methoxyethyl)aminosulfonyl]-2-hydroxyphenyl] urea;
N-[4-chloro-3-[N",N"-di-(2-methoxyethyl)aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-3-[N"-[2-(dimethylamino)ethyl]aminosulfonyl]-2-hydroxyphenyl] urea hydrochloride;

N-[4-chloro-3-[N"-[2-(dimethylamino)ethyl]aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride;
N-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfonyl)propyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfonyl)propyl]aminosulfonyl]phenyl] urea;
N-[4-chloro-2-hydroxy-3-[N"-[2-(morpholinyl)ethyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride;
N-[4-chloro-2-hydroxy-3-[N"-[2-(morpholinyl)ethyl]aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea hydrochloride;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[2-(4-morpholinyl)ethyl]aminosulfonyl]phenyl] urea;
N-[4-chloro-2-hydroxy-3-(4-thiomorpholinylsulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(4-thiomorpholinylsulfonyl)phenyl] urea;
N-(2-bromophenyl)-N'-[4-chloro-3-[N",N"-di-(2-hydroxyethyl)aminosulfonyl]-2-hydroxyphenyl] urea;
N-[4-chloro-3-[N",N"-di-(2-hydroxyethyl)aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea,
N-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfinyl)propyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfinyl)propyl]aminosulfonyl]phenyl] urea;
N-(2-bromophenyl)-N'-[3-[N"-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea,
N-[3-[N"-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;
N-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl] urea;
N-[4-chloro-2-hydroxy-3-[N"-[(piperidin-4-yl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea trifluroacetate;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[(piperidin-4-yl)methyl]aminosulfonyl]phenyl] urea hydrochloride;
N-[3-(1-azetidinylsulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea;
N-[3-(1-azetidinylsulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea;

N-[3-(1-azetidinylsulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-3-(N",N"-dimethylaminosulfonyl)-2-hydroxyphenyl] urea potassium salt;

N-(2-bromophenyl)-N'-[4-chloro-3-(N",N"-dimethylaminosulfonyl)-2-hydroxyphenyl] urea sodium salt;

N-(2-bromophenyl)-N'-[4-chloro-3-(N"-cyclopropylaminosulfonyl)-2-hydroxyphenyl) urea;

N-[4-chloro-3-(N"-cyclopropylaminosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea;

N-[4-chloro-3-(N"-cyclopropylaminosulfonyl)-2-hydroxphenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-propylaminosulfonyl)phenyl] urea;

N-[4-chloro-2-hydroxyl-3-(N"-propylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea;

N-[4-chloro-2-hydroxyl-3-(N"-propylaminosulfonyl)phenyl]-N'-(2-chlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-3-(N"-ethylaminosulfonyl])-2-hydroxyphenyl] urea;

N-[4-chloro-3-(N"-ethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea;

N-[4-chloro-3-(N"-ethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxylpentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea;

N-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxylpentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;

N-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxylpentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(2-hydroxyethyl)aminosulfonyl] urea;

N-(2,3-dichlorophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(2-hydroxyethyl)aminosulfonyl] urea;

N-(2-bromophenyl)-N'-[3-[N"-[[(2-bromophenylamino)carboxyl]ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea;

N-[3-[N"-(2-benzyloxyethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2 bromophenyl) urea;

N-[2-Hydroxy-3-(N"-cyclopropylmethylaminosulfonyl)-4-chlorophenyl]-N'-(2,3-dichlorophenyl) urea;

N-[2-Hydroxy-3-(N"-cyclopropylmethylaminosulfonyl)-4-chlorophenyl]-N'-(2 chlorophenyl) urea;

N-[2-Hydroxy-3-(N"-cyclopropylmethylaminosulfonyl)-4-chlorophenyl]-N'-(2 bromophenyl) urea;

N-[2-Hydroxy-3-(N"-methoxy-N"-methylaminosulfonyl)-4-chlorophenyl]-N'-(2-bromophenyl) urea;

N-[2-Hydroxy-3-(N"-methoxy-N"-methylaminosulfonyl)-4-chlorophenyl]-N'-(2 chlorophenyl) urea;
N-[2-Hydroxy-3-(N"-methoxy-N"-methylaminosulfonyl)-4-chlorophenyl]-N'-(2,3 dichlorophenyl) urea;
N-[2-Hydroxy-3-(N"-pyrrolidinylsulfonyl)-4-chlorophenyl]-N'-(2,3-dichlorophenyl) urea;
N-[2-Hydroxy-3-(N"-pyrrolidinylsulfonyl)-4-chlorophenyl]-N'-(2-bromophenyl) urea;
N-[2-Hydroxy-3-(N"-pyrrolidinylsulfonyl)-4-chlorophenyl]-N'-(2-chlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(4-pyridinylaminosulfonyl]phenyl] urea;
N-[4-chloro-2-hydroxy-3-[(4-pyridinylaminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[[[2-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] urea;
N-[4-chloro-2-hydroxy-3-[[[2-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] -N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[[[(2R)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] urea; and
N-[4-chloro-2-hydroxy-3-[[[(2R)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[[[(2S)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] urea;
N-[4-chloro-2-hydroxy-3-[[[(2S)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-cyclopentylaminosulfonyl)phenyl]urea
N-[4-chloro-2-hydroxy-3-(N"-cyclopentylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea, and N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-cyclopentylaminosulfonyl)phenyl]urea
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl) phenyl]urea
N-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea
N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl) phenyl]urea
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-tetrahydroisoxazylaminosulfonyl) phenyl]urea
N-[4-chloro-2-hydroxy-3-(N"-tetrahydroisoxazylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea

N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-N"-(tetrahydroisoxazylaminosulfonyl) phenyl]urea

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl)aminosulfonyl]phenyl] urea

N-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

N-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl)aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(2-ethoxyethyl)aminosulfonyl]phenyl] urea

N-[4-chloro-2-hydroxy-3-[(2-ethoxyethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

N-[4-chloro-2-hydroxy-3-[(2-ethoxyethyl)aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(2-methoxycarbonyl)azetidin-1-yl]sulfonylphenyl] urea

N-[4-chloro-2-hydroxy-3-[(2-methoxycarbonyl)azetidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea

N-[4-chloro-2-hydroxy-3-[(2-carboxy)-azetidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[3-(4-morpholinyl)propyl]aminosulfonyl]phenyl] urea hydrochloride

N-[4-chloro-2-hydroxy-3-[N"-[3-(4-morpholinyl)propyl]-aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride and N-[4-chloro-2-hydroxy-3-[N"-[3-(4-morpholinyl)propyl]aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea hydrochloride

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylphenyl] urea

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(-)-(2-hydroxymethyl)pyrrolidin-1-yl]sulfonylphenyl] urea

N-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea

N-[4-chloro-2-hydroxy-3-[S-(-)-(2-hydroxymethyl)-pyrrolidin-1-ylsulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

N-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)-pyrrolidin-1-yl]sulfonylphenyl]-N'-(2-chlorophenyl) urea

N-[4-chloro-2-hydroxy-3-[S-(-)-(2-hydroxymethyl)-pyrrolidin-1-yl]sulfonylphenyl]-N'-(2-chlorophenyl) urea

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(2-methoxycarbonyl)pyrrolidin-1-yl]sulfonylphenyl] urea

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(2-carboxy)pyrrolidin-1-yl]sulfonylphenyl] urea

N-(2-bromophenyl)-N'-[3-[N"-(tert-butyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea

N-[3-[N"-(tert-butyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea and N-[3-[N"-(tert-butyl)aminosulfonyl]-4-chloro-2-hydroxylphenyl]-N'-(2-chlorophenyl) urea

N-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea

N-[3-[N"-(5-amino-5-carboxypentyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea hydrochloride

N-[3-[N"-(5-amino-5-carboxypentyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride

N-[3-[N"-(5-amino-5-carboxypentyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea hydrochloride

N-[4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

N-(2-bromophenyl)-N'-[4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyphenyl] urea

N-[4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea

N-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

N-[3-[N"-(2-aminoethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate

N-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea

N-[3-[N"-(2-aminoethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea trifluoroacetate

N-[4-chloro-2-hydroxy-3- (N",N"-dimethylaminosulfonyl)phenyl]-N'-(2-chlorophenyl) urea.

N-[4-chloro-2-hydroxy-3-(aminosulfonyl)phenyl]-N'-(2-bromo-3-fluorophenyl) urea

N-[4-chloro-2-hydroxy-3-(aminosulfonyl)phenyl]-N'-(2-chloro-3-fluorophenyl) urea

N-(2-bromophenyl)-N'-[4-chloro-3-[(1-ethyl-pyrrolidin-2-yl)methylaminosulfonyl]-2-hydroxyphenyl] urea hydrochloride

N-[4-chloro-3-[(1-ethyl-pyrrolidin-2-yl)methylaminosulfonyl]-2-hydroxyphenyl] N'-(2,3-dichlorophenyl) urea hydrochloride

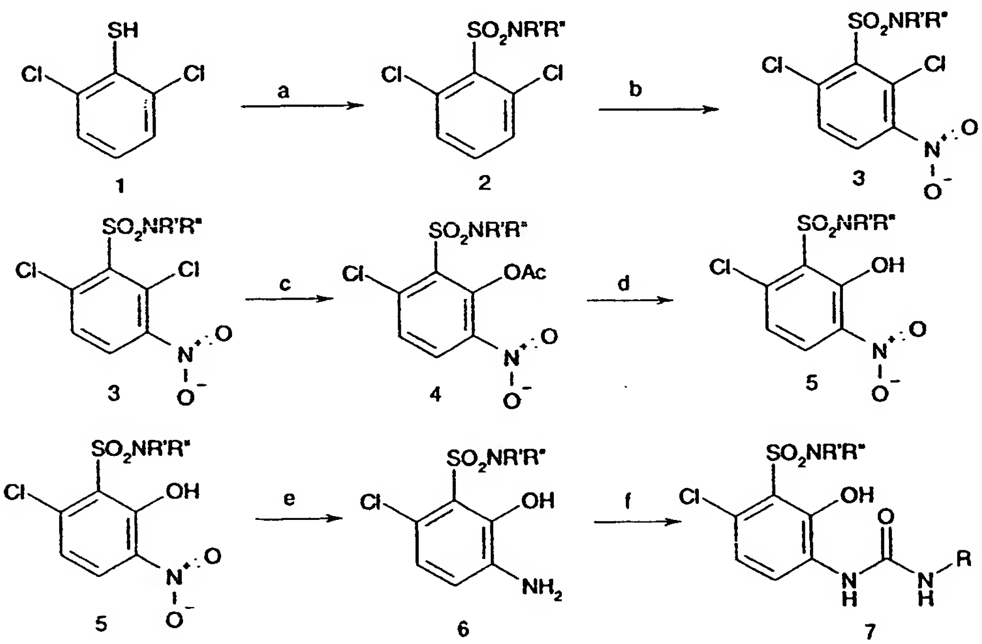
N-[4-chloro-3-[(1-ethyl-pyrrolidin-2-yl)methylaminosulfonyl]-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea hydrochloride

or a pharmaceutically acceptable salt thereof.

METHODS OF PREPARATION

The compounds of Formulas (I) to (VII) may be obtained by applying synthetic procedures, some of which are illustrated in the Schemes below. The synthesis provided for in these Schemes is applicable for the producing compounds of Formulas (I) to (VII), having a variety of different R, R_1, and Z groups which are reacted, employing optional substituents which are suitably protected, to achieve compatibility with the reactions outlined herein. Subsequent deprotection, in those cases, then affords compounds of the nature generally disclosed. Once the urea nucleus has been established, further compounds of these formulas may be prepared by applying standard techniques for functional group interconversion, well known in the art.

Scheme 1

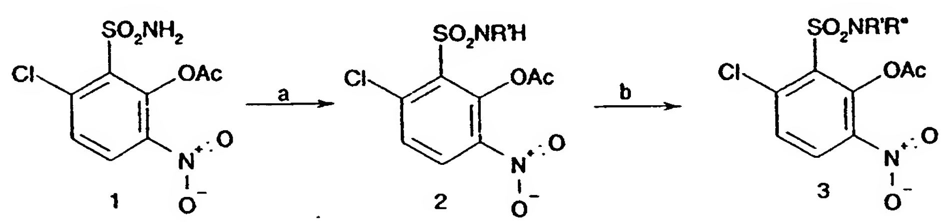


a)i)NCS, AcOH, H_2O, ii NR'R"H, pyr b)H_2SO_4, HNO_3 c)NaOAc, 18-crown-6 d)H_2SO_4, MeOH e) Pd/C, H_2 f)RCNO, DMF

The desired 4-chloro-N-(3-sulfonamido-2-hydroxyphenyl)-N"-phenyl urea can be synthesized from the commercially available 2,6-dichlorothiophenol using the procedure elaborated in Scheme 1. The thiol can be oxidized to the corresponding sulfonyl halide

using a halogenating agent, such as NCS, NBS, Cl_2 or Br_2, in the presence of a protic solvent, such as water, acetic acid, or an alcohol or combination thereof. The yield may be increased if a buffering agent, such as sodium or potassium acetate is included in the reaction mixture, and the reaction is conducted at or below room temperature. The corresponding sulfonyl halide can then be condensed with an amine in presence of a base such as pyridine, triethyl amine, potassium carbonate or sodium hydride to form the analogous sulfonamide 2-scheme 1. The dichlorosulfonamide 2-scheme 1 can be nitrated using strong nitrating conditions such as nitric acid in sulfuric acid to form the aromatic nitro compound 3-scheme 1. The chlorine ortho to the nitro group can be selectively hydrolyzed using acetate salt such as sodium acetate in the presence of a crown ether, such as 18-crown-6, to form the acetate 4-scheme 1. The acetate group can be hydrolyzed under acidic conditions in an alcohol solvent such as methanol or ethanol with a catalytic amount of acid to form the phenol 5-scheme 1. The nitro can be reduced by conditions well known in the art such as hydrogen and palladium on carbon, tin chloride in methanol, zinc in acetic acid or thiol to form the corresponding aniline 5-scheme 1. The aniline can then be coupled with a commercially available isocyanate or thioisocyanate to form the desired urea or thio urea. Alternatively the desired isocyanates can be made by condensing the amine with triphosgene in the presence of base (such as potassium carbonate) or by reacting the carboxylic acid with diphenyl phosphorazide in the presence of a base (such as triethyl amine).

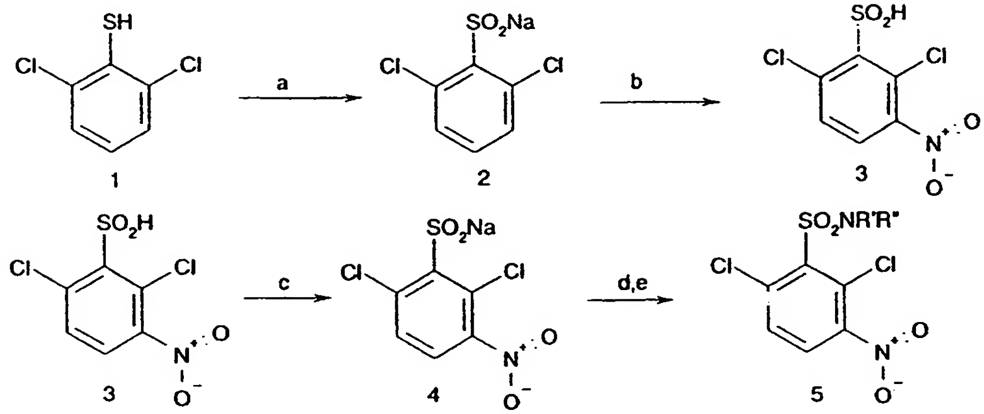
Scheme 2



a)NaH, R'X b)NaH R"X

If the sulfonamide 1-scheme 2 (3-scheme 1) is unfunctionalized R'=R"=H then it can be functionalized as required herein, by alkylation. The sulfonamide is deprotonated using a base such as sodium hydride and then alkylated using an alkyl halide such as benzyl bromide or methyl iodide form 2-scheme 2. The sulfonamide can then be alkylated a second time using sodium hydride and another alkyl halide to form 3-scheme 2. This compound can then be converted to the desired urea using the process elaborated in scheme 1.

Scheme 3

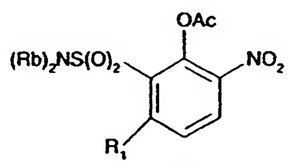


a)i)NCS, AcOH, H_2O ii)NaOH MeOH b)H_2SO_4, HNO_3 c)NaOH MeOH d) PCl_5, $POCl_3$ e)NHR'R", Et_3N

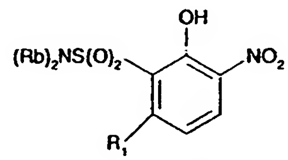
An alternative route to 5-scheme 3 (3-scheme 1) is outlined above, in scheme 3 wherein the commercially available 2,6-dichloro thiol can be oxidized to the sulfonyl halide using a halogenating agent such as NCS, NBS, chlorine or bromine in the presence of a protic solvent such as alcohol, acetic acid or water. The sulfonyl halide can be hydrolyzed by using a metal hydroxide such as sodium or potassium hydroxide to form the corresponding sulfonic acid salt. The sulfonic acid salt can then be nitrated under nitration conditions such as nitric acid in a solvent of strong acid such as sulfuric acid to form the nitro phenyl sulfonic acid 3-scheme 3. The sulfonic acid 3-scheme 3 can be converted to the sulfonamide 5-scheme 3 using a three step procedure involving the formation of the metal salt using a base such as sodium hydroxide, sodium hydride or sodium carbonate to form 4-scheme 3. The sulfonic acid salt is then converted to the sulfonyl chloride using PCl_5 with $POCl_3$ as a solvent. The sulfonyl chloride can then be converted to the corresponding sulfonamide using the desired amine HNR'R" in triethyl amine at temperatures ranging from –78 °C to 60 °C to form the corresponding sulfonamide 5-scheme 3 (3-scheme 1). The sulfonamide 5-scheme 3 can be further elaborated by the methods contained in scheme 1. This method is not limited to the 2,6-dichlorophenyl thiol it can also be applied to the 2,6-difluorophenyl thiol, 2,6-dibromophenyl thiol and the 2,6-diiodophenyl thiol. The halogens in these compounds can be converted to the corresponding cyano, amino, thiol, or alkoxy compounds by nucleophilic displacement reactions using nucleophiles such as alkyl thiolates, alkoxides, amine and cyanides. The halogens can also be further functionalized by palladium coupling and carbonylation

reactions, well known in the art, to form the corresponding amido, carbonyl, alkenyl, alkyl, phenyl and heterocycic substituted products as required by Formula (I) to (VII).

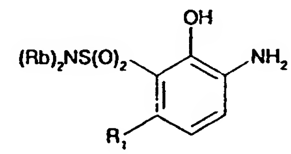
Novel intermediates of the present invention involve compounds of formula (II), (III), (IV), (V), (VI) and (VII):



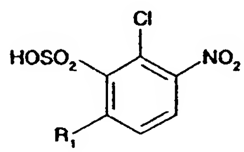
(II)



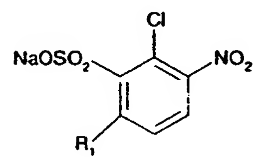
(III)



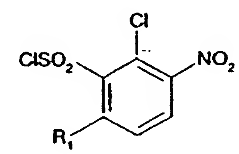
(IV)



(V)



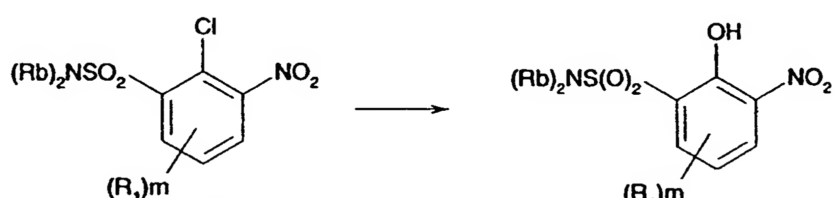
(VI)



(VII)

wherein R_1 is not hydrogen.

Novel synthetic steps disclosed by the present invention include the conversion of a chloro compound of formula (VII) to the phenol of formula (III) using sodium acetate and 18-C-6 followed by hydrolysis with sulfuric acid and methanol and the same transformation achieved in one step using sodium hydride and water in THF.



(VII) (III)

A second novel synthetic step involves the nitration of the sulfonic acid or sodium salt of formula (VIII) to the nitro compound of formula (IX) using nitric acid in sulfuric acid.

R = H or Na

SYNTHETIC EXAMPLES

The invention will now be described by reference to the following examples, which are merely illustrative and are not to be construed as a limitation of the scope of the present invention. All temperatures are given in degrees centigrade, all solvents are highest available

purity and all reactions run under anhydrous conditions in an argon atmosphere unless otherwise indicated.

In the Examples, all temperatures are in degrees Centigrade (°C). Mass spectra were performed upon a VG Zab mass spectrometer using fast atom bombardment, unless otherwise indicated. ^{1}H-NMR (hereinafter "NMR") spectra were recorded at 250 MHz using a Bruker AM 250 or Am 400 spectrometer. Multiplicities indicated are: s=singlet, d=doublet, t=triplet, q=quartet, m=multiplet and br indicates a broad signal. Sat. indicates a saturated solution, eq indicates the proportion of a molar equivalent of reagent relative to the principal reactant. The purification, yields and spectral characteristics for each individual compound are listed below.

Example 1

Preparation of N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea sodium salt, and N-(2-bromophenyl)-N'-(4-chloro-2-hydroxy-3-aminosulfonylphenyl) urea

2,6-Dichlorobenzenesulfonyl chloride

Into a mixture of 200 milliliters (hereinafter "mL") of acetic acid, water and dichloromethane (3/1/4, v/v/v), 2,6-dichlorobenzenethiol (10.0 grams (hereinafter "g"), 55.8 millimoles (hereinafter "mmol"), N-chlorosuccinimide (37.28 g, 279 mmol) and potassium acetate (2.29 g, 27.9 mmol) were added. The resulting mixture was stirred at 0°C, then warmed to room temperature overnight. The mixture was then diluted with 200 mL of dichloromethane, and washed with water (100 mL x 3). The organic layer was dried (Na_2SO_4) and concentrated to give the desired product (11 g, 80%). ^{1}H NMR ($CDCl_3$): δ 7.57 (d, 2H), 7.47 (t, 1H).

2,6-Dichlorobenzenesulfonamide

A solution of 2,6-dichlorobenzenesulfonyl chloride (10.50 g, 42.77 mmol) in 100 mL of pyridine was added dropwise to 100 mL of pyridine while anhydrous ammonia gas was bubbled through the solution. After 4 hours at 0°C, the mixture was acidified to pH >1 with 6N aq. HCl, then extracted with ethyl acetate. The combined organic layer was then dried (Na_2SO_4) and concentrated to give the desired product (8.69 g, 90%). EI-MS (m/z) 225.0, 227.1 (M^-).

2,6-Dichloro-3-nitrobenzenesulfonamide

Into a solution of 2,6-dichlorobenzenesulfonamide (7.8 g, 34.5 mmol) in 30 mL of concentrated sulfuric acid at 0°, nitric acid (1.74 mL, 41.4 mmol) was added dropwise. The mixture was stirred at 0°C for 2 hours, then 200 mL of water was added to produce a precipitate. The resulting mixture was filtered. The white solid was collected, washed with

water and dried *in vacuo* to give the desired product (7.17 g, 76%). ^{1}H NMR (DMSO-d_6): δ 8.25 (s, 2H), 8.20 (d, 1H), 7.92 (d, 1H).

2-Acetyl-6-chloro-3-nitrobenzenesulfonamide

A solution of 2,6-dichloro-3-nitrobenzenesulfonamide (2.04 g, 7.5 mmol), potassium acetate (2.21 g, 22.5 mmol) and 18-crown-6 (5.95 g, 22.5 mmol) in 50 mL of dimethyl sulfoxide was heated to 45°C for 7 days. The mixture was acidified with 1N aq. HCl, and extracted with ethyl acetate. The organic layer was concentrated to give the crude material. Column chromatography on silica gel, eluting with ethyl acetate/hexane/acetic acid (50/49/1, v/v/v) gave the desired product (1.67 g, 76%). EI-MS (m/z) 293.1, 295.1 (M^-).

6-Chloro-2-hydroxy-3-nitrobenzenesulfonamide

A solution of 2-acetyl-6-chloro-3-nitrobenzenesulfonamide (1.72 g, 5.83 mmol), chlorotrimethylsilane (2 mL) and fuming sulfuric acid (0.5 mL) in methanol was heated to reflux for 20 hours. The solvent was evaporated. The residue was diluted with ethyl acetate and washed with water. The organic layer was then dried (Na_2SO_4) and concentrated to give the desired product (1.0 g, 68%). EI-MS (m/z) 251.1, 253.2 (M^-).

3-Amino-6-chloro-2-hydroxybenzenesulfonamide

To a solution of 6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (1.1 g, 4.36 mmol) in ethyl acetate, was added 10 % Pd/C (500 mg). The mixture was flushed with argon, and then stirred under a hydrogen atmosphere at balloon pressure for 4 hours at room temperature. The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated to give the desired product (0.9g, 93%). EI-MS (m/z) 221.1, 223.1 (M^-).

N-(4-Chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea

A solution of 3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.88 g, 3.9 mmol) and 2,3-dichlorophenylisocyanate (0.62 mL, 4.6 mmol) in 5 mL of N,N-dimethyl-formamide was stirred at room temperature for 20 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (30/70 to 50/50, v/v), followed by recrystallization from dichloromethane and hexane, gave the desired product (1.18 g, 74%). mp 241-242°C.

N-(2-Bromophenyl)-N'-(4-chloro-2-hydroxy-3-aminosulfonylphenyl) urea

A solution of 3-amino-6-chloro-2-hydroxybenzenesulfonamide (65 mg, 0.29 mmol) and 2,3-dichlorophenylisocyanate (45 µL, 0.36 mmol) in 2 mL of N,N-dimethyl-formamide was stirred at room temperature for 20 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (30/70 to 40/60, v/v), gave the desired product (50 mg, 41%). EI-MS (m/z) 418.2, 420.2, 422.2 (M^-).

N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea sodium salt

To a solution of N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea (1.47 g, 59 mmol) in 150 mL of acetone was added 2.46 mL of aq. NaOH solution (1.45 M). The mixture was stirred for 16 hours at room temperature and the solvent was evaporated. The residue was recrystallized from acetone and dichloromethane to give the desired product (1.41 g, 91%). ^{1}H NMR (DMSO-d_6): δ 9.27 (s, 2H), 8.01 (m, 3H), 7.77 (d, 1H), 7.26 (m, 2H), 6.05 (d, 1H)

Examples 2 & 3

Preparation of N-[3-(N''-benzylaminosulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea and N-[3-(N''-benzylaminosulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea

N-Benzyl-2-acetyl-6-chloro-3-nitro-benzenesulfonamide

A mixture of 2-acetyl-6-chloro-3-nitrobenzenesulfonamide (500 mg, 1.69 mmol), potassium carbonate (469 mg, 3.39 mmol) and benzyl bromide (0.24 mL, 2.0 mmol) in 20 mL of N,N-dimethylformamide was heated to 75°C for 24 hours. The mixture was acidified with 1N aq. HCl, then extracted with ethyl acetate. The solvent was concentrated to give the crude material. Column chromatography on silica gel, eluting with ethyl acetate/hexane/acetic acid (50/49/1, v/v/v), gave the desired product (274 mg, 42%). EI-MS (m/z) 383.3, 385.3 (M^-).

N-Benzyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

A solution of N-benzyl-2-acetyl-6-chloro-3-nitrobenzenesulfonamide (225 mg, 0.59 mmol), 0.1 mL of chlorotrimethylsilane and 2 drops of fuming sulfuric acid in ethanol was heated to reflux for 20 hours. The solvent was evaporated. The residue was diluted with ethyl acetate and washed with water. The organic layer was then dried (Na_2SO_4) and concentrated to give the desired product (189 mg, 94%). ^{1}H NMR (DMSO-d_6): δ 7.92 (d, 1H), 7.18 (m, 5H), 6.93 (d, 1H), 4.15 (s, 2H).

N-Benzyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide

To a solution of N-benzyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (180 mg, 0.52 mmol) in ethyl acetate, was added 10% Pd/C (70 mg). The mixture was flushed with argon, then stirred under a hydrogen atmosphere at balloon pressure for 1 hour at room temperature. The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated to give the desired product (140 mg, 85%). ^{1}H NMR (DMSO-d_6): δ 8.73 (t, 1H), 7.24 (m, 5H), 6.78 (d, 1H), 4.09 (d, 2H).

N-[3-(N"-Benzylaminosulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea
A solution of N-benzyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (54 mg, 0.17 mmol) and 2,3-dichlorophenylisocyanate (34 µL, 0.26 mmol) in 2 mL of N,N-dimethylformamide was stirred at room temperature for 20 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (60/40, v/v), gave the desired product (10 mg, 12%). EI-MS (m/z) 498.2, 500.1, 502.1 (M^-).

N-[3-(N"-Benzylaminosulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea
A solution of N-benzyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (80 mg, 0.26 mmol) and 2-bromophenylisocyanate (47 µL, 0.38 mmol) in 2 mL of N,N-dimethylformamide was stirred at room temperature for 20 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (30/70 to 70/30, v/v), gave the desired product (80 mg, 61%). EI-MS (m/z) 508.1, 510.2, 512.2 (M^-).

Examples 4 & 5

Preparation of N-[4-chloro-3-(N",N"-dimethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea and N-(2-bromophenyl)-N'-[4-chloro-3-(N",N"-dimethylaminosulfonyl)-2-hydroxyphenyl] urea

N,N-dimethyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide
To a mixture of 2-acetyl-6-chloro-3-nitrobenzenesulfonamide (300 mg, 1.02 mmol) and sodium hydride (122 mg, 3.06 mmol) in 10 mL of N,N-dimethylformamide, was added iodomethane (0.64 mL, 10.2 mmol). The mixture was stirred at room temperature for 20 hours. The resulting mixture was acidified with 1N aq. HCl, then extracted with ethyl acetate. The solvent was concentrated to give the crude material. Column chromatography on silica gel, eluting with ethyl acetate/hexane/acetic acid (50/49/1, v/v/v), gave the desired product (140 mg, 49%). ^{1}H NMR (DMSO-d_6): δ 8.05 (d, 1H), 7.03 (d, 1H), 2.87 (s, 6H).

N,N-Dimethyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide.

To a solution of N,N-dimethyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (140 mg, 0.50 mmol) in ethyl acetate, was added 10% Pd/C (50 mg). The mixture was flushed with hydrogen, then stirred under a hydrogen atmosphere at balloon pressure for 1.5 hours at room temperature. The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated to give the desired product (100 mg, 80%). ^{1}H NMR (DMSO-d_6): δ 6.87 (d, 1H), 6.80 (d, 1H), 2.82 (s, 6H).

N-[4-Chloro-3-(N",N"-dimethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea.

A solution of N,N-dimethyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (80 mg, 0.32 mmol) and 2,3-dichlorophenylisocyanate (50 µL, 0.38 mmol) in 2 mL of N,N-dimethylformamide was stirred at room temperature for 20 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (20/80, v/v), followed by recrystallization from ethyl acetate and hexane, gave the desired product (63 mg, 45%). ^{1}H NMR (DMSO-d_6): δ 10.51 (s, 1H), 9.34 (s, 1H), 9.27 (s, 1H), 8.29 (d, 1H), 7.32 (m, 2H), 7.16 (d, 1H), 2.87 (s, 6H).

N-(2-Bromophenyl)-N'-[4-chloro-3-(N",N"-dimethylaminosulfonyl)-2-hydroxyphenyl] urea.
A solution of N,N-dimethyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (80 mg, 0.32 mmol) and 2-bromophenylisocyanate (47 µL, 0.38 mmol) in 2 mL of N,N-dimethylformamide was stirred at room temperature for 20 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (20/80, v/v), followed by recrystallization from ethyl acetate and hexane, gave the desired product (88 mg, 62%). EI-MS (m/z) 446.2, 448.3, 450.3 (M^-).

Examples 6 & 7

Preparation of N-[4-chloro-2-hydroxy-3-(N"-methylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea and N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-methylaminosulfonyl)phenyl] urea

N-Methyl-2-acetyl-6-chloro-3-nitrobenzenesulfonamide.
To a mixture of 2-acetyl-6-chloro-3-nitrobenzenesulfonamide (300 mg, 1.02 mmol) and sodium hydride (53 mg, 1.32 mmol) in 10 mL of N,N-dimethylformamide, iodomethane (70 µL, 1.12 mmol) was added. The mixture was stirred at room temperature for 66 hours. The mixture was acidified with 1N aq. HCl, then extracted with ethyl acetate. The solvent was concentrated to give the crude material. Column chromatography on silica gel, eluting with

ethyl acetate/hexane/acetic acid (50/49/1, v/v/v), gave the desired product (185 mg, 59%). EI-MS (m/z) 307.3, 309.3 (M^-).

N-Methyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide.

A solution of N-methyl-2-acetyl-6-chloro-3-nitrobenzenesulfonamide (170 mg, 0.55 mmol), 0.5 mL of chlorotrimethylsilane and 3 drops of fuming sulfuric acid in ethanol was heated to reflux for 20 hours. The solvent was evaporated. The residue was diluted with ethyl acetate and washed with water. The organic layer was then dried (Na_2SO_4) and concentrated to give the desired product (160 mg, >100%). EI-MS (m/z) 265.2, 267.2 (M^-).

N-Methyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide.

To a solution of N-methyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (140 mg, 0.53 mmol) in ethyl acetate, was added 10% Pd/C (60 mg). The mixture was flushed with argon, then stirred under a hydrogen atmosphere at balloon pressure for 1.5 hours at room temperature. The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated to give the desired product (160 mg, >100%). ^1H NMR (DMSO-d_6): δ 7.95 (bs, 1H), 6.85 (d, 1H), 6.79 (d, 1H), 2.48 (d, 3H).

N-[4-chloro-2-hydroxy-3-(N"-methylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea

A solution of N-methyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (70 mg, 0.29 mmol) and 2,3-dichlorophenylisocyanate (57 μL, 0.44 mmol) in 2 mL of N,N-dimethylformamide was stirred at room temperature for 66 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (30/70, v/v), gave the desired product (60 mg, 49%, three steps). EI-MS (m/z) 422.3, 424.3, 426.3 (M^-).

N'-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-methylaminosulfonyl)phenyl] urea

A solution of N-methyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (70 mg, 0.29 mmol) and 2-bromophenylisocynate (55 μL, 0.44 mmol) in 2 mL of N,N-dimethylformamide was stirred at room temperature for 66 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (30/70, v/v), gave the desired product (85 mg, 67%, three steps). EI-MS (m/z) 432.2, 434.2, 436.3 (M^-).

<u>Example 8, 9, 10 & 11</u>

<u>Preparation of N-[4-chloro-2-hydroxy-3-[N"-[2-(methoxycarbonyl)-methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea , N-[3-[N"-(2-</u>

carboxymethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea , N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[2-(methoxycarbonyl)methyl]-aminosulfonyl]phenyl] urea , and N-(2-bromophenyl)-N'-[3-[N"-(2-carboxymethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea

N-[2-(methoxycarbonyl)methyl]-2-acetyl-6-chloro-3-nitrobenzenesulfonamide

To a mixture of 2-acetyl-6-chloro-3-nitrobenzenesulfonamide (300 mg, 1.02 mmol) and sodium hydride (81 mg, 2.02 mmol) in 10 mL of N,N-dimethylformamide, was added methyl bromoacetate (106 μL, 1.12 mmol). The mixture was heated to 80°C for 20 hours, followed by adding more sodium hydride (81 mg, 2.02 mmol) and stirring at room temperature for 66 hours. The resulting mixture was acidified with 1N aq. HCl, then extracted with ethyl acetate. The solvent was concentrated to give the crude material. Column chromatography on silica gel, eluting with ethyl acetate/hexane/acetic acid (60/39/1, v/v/v), gave the desired product (350 mg, 95%). ^{1}H NMR (DMSO-d_6): δ 7.76 (d, 1H), 6.12 (d, 1H), 4.57 (s, 2H), 3.66 (s, 3H), 2.22 (s, 3H).

N-[2-(methoxycarbonyl)methyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

A solution of N-[2-(methoxycarbonyl)methyl]-2-acetyl-6-chloro-3-nitrobenzenesulfonamide (350 mg, 0.95 mmol), 0.5 mL of chlorotrimethylsilane and 3 drops of fuming sulfuric acid in methanol was heated to reflux for 20 hours. The solvent was evaporated. The residue was diluted with ethyl acetate and washed with water. The organic layer was then dried (Na_2SO_4) and concentrated to give the desired product (182 mg, 59%). EI-MS (m/z) 323.0, 325.0 (M^-).

N-[2-(methoxycarbonyl)methyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide

To a solution of N-[2-(methoxycarbonyl)methyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (170 mg, 0.52 mmol) in ethyl acetate, was added 10% Pd/C (80 mg). The mixture was flushed with hydrogen, then stirred under a hydrogen atmosphere at balloon pressure for 3 hours at room temperature. The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated to give a mixture of the desired product and impurity. The mixture was used for next step without further purification. ^{1}H NMR (DMSO-d_6): δ 8.68 (m, 1H), 6.85 (d, 1H), 6.79 (d, 1H), 3.83 (s, 2H), 3.53 (s, 3H).

N-[4-chloro-2-hydroxy-3-[N"-[2-(methoxycarbonyl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

A solution of N-[2-(methoxycarbonyl)methyl]-3-amino-6-chloro-2-hydroxybenzene-sulfonamide (0.26 mmol) and 2,3-dichlorophenylisocyanate (41 µL, 0.31 mmol) in 2 mL of N,N-dimethylformamide was stirred at room temperature for 20 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (40/60, v/v), gave the desired product (35 mg, 28% for two steps). EI-MS (m/z) 479.9, 482.0, 483.9 (M^-).

N-[3-[N"-(2-carboxymethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

A mixture of N-[4-chloro-2-hydroxy-3-[N"-[2-(methoxycarbonyl)methyl]-aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea (20 mg, 0.041 mmol) and lithium hydroxide monohydrate (40 mg, 0.95 mmol) in 5 mL of methanol (95%) was stirred at room temperature for 20 hours. The mixture was acidified with 1N aq. HCl to produce white precipitate. The resulting mixture was then filtered, the white solid was collected and dried in vacuo to give the desired product (15 mg, 78%). EI-MS (m/z) 465.9, 467.9, 469.9 (M^-).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[2-(methoxycarbonyl)methyl]-aminosulfonyl]phenyl] urea

A solution of N-[2-(methoxycarbonyl)methyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.26 mmol) and 2-bromophenylisocyanate (38 µL, 0.31 mmol) in 2 mL of N,N-dimethylformamide was stirred at room temperature for 20 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (30/70, v/v), gave the desired product (40 mg, 31% for two steps). EI-MS (m/z) 489.9, 491.9, 493.9 (M^-).

N-(2-bromophenyl)-N'-[3-[N"-(2-carboxymethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea

A mixture of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[2-(methoxycarbonyl)methyl]aminosulfonyl]phenyl] urea (15 mg, 0.03 mmol) and lithium hydroxide monohydrate (20 mg, 0.48 mmol) in 5 mL of methanol (95%) was stirred at room temperature for 20 hours. The mixture was acidified with 1N aq. HCl to produce white precipitate. The resulting mixture was then filtered, the white solid was collected and dried in vacuo to give the desired product (10 mg, 70%). 476.1, 478.1, 490.1 (M^-).

Using analagous methods to those indicated above the following additional compound have been prepared:

Example 12: N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2-chlorophenyl) urea

A solution of 3-amino-6-chloro-2-hydroxybenzenesulfonamide (40mg, 0.18mmol) and 2-chlorophenylisocyanate (33 mg, 0.22mmol) in 1 mL of N,N-dimethyl-formamide was stirred at room temperature for 18 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (30/70, v/v), followed by recrystallization from acetone and hexane, gave the desired product (30mg, 44 %). EI-MS (m/z) 374.3, 376.1 (M^-).

Example 13: Preparation of N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-phenyl urea

Following the general procedure for urea formation outlined in example 12, 3-amino-6-chloro-2-hydroxybenzenesulfonamide (40mg, 0.18mmol) and phenylisocyanate (32mg, 0.27mmol) were coupled to form the desired urea (25mg, 41%). EI-MS (m/z) 340.3, 342.3 (M^-).

Example 14: N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2-phenoxyphenyl) urea

Following the general procedure for urea formation outlined in example 12, 3-amino-6-chloro-2-hydroxybenzenesulfonamide (40mg, 0.18mmol) and 2-phenoxyphenylisocyanate (46mg, 0.22mmol) were coupled to form the desired urea (41mg, 52%). ^1H NMR (DMSO-d_4): δ 10.69 (s, 1H), 9.25 (2, 1H), 9.11 (s, 1H), 8.18 (m, 4H), 7.41 (m, 2H), 7.04 (m, 8H), 6.84 (d, 1H).

Example 15 and 16: Preparation of N-[4-chloro-2-hydroxy-3- [N"-(2-methoxyethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea sodium salt and N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(2-methoxyethyl)-aminosulfonyl]phenyl] urea

The following is the general procedure for sulfonamide formation

N-(2-methoxyethyl)-2,6-dichloro-3-nitrobenzenesulfonamide

Into a solution of 2,6-dichloro-3-nitrobenzenesulfonyl chloride (600mg, 2.06mmol) in 15 mL of dichloromethane at –78°C was added dropwise a solution of 2-methoxyethylamine (155 mg, 2.06 mmol) and triethylamine (770µL, 5.15mmol) in 10 mL of dichloromethane.

The mixture was warmed to room temperature and stirred for 16 hours. The mixture was acidified to pH >1 with 1N aq. HCl, then extracted with ethyl acetate. The combined organic layer was then concentrated to give the crude material. Column chromatography on silica gel, eluting with ethyl acetate/hexane (30/70, v/v/), gave the desired (640mg, 94%). EI-MS (m/z) 327.1, 329.1 (M^-).

The following is the general procedure for the hydrolysis of dichlorosulfonamide to phenol

N-(2-methoxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

A mixture of N-(2-methoxyethyl)-2,6-dichloro-3-nitrobenzenesulfonamide (490 mg, 1.49 mmol), 60% sodium hydride (179 mg, 4.47 mmol) and water (27 μL, 1.49 mmol) was heated to 35 °C while kept at argon atmosphere for 3 days. The reaction was monitored by ^1H NMR. 0.1 equivalent water was added to the mixture when the reaction was not completed. The solvent was evaporated when the reaction almost completed indicated by ^1H NMR. The residue was diluted with ethyl acetate and washed with 1N aq. HCl. The solvent was concentrated to give the crude material. Column chromatography on silica gel, eluting with ethyl acetate/hexane/acetic acid (40/58/2, v/v/v), gave the desired product (270mg, 58%). EI-MS (m/z) 309.1, 311.1 (M^-).

The following is the general procedure for the hydrogenation of nitro compound to aniline

N-(2-methoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

To a solution of N-(2-methoxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (260 mg, 0.84 mmol) in ethyl acetate, was added 10% Pd/C (100mg). The mixture was flushed with argon, and then stirred under a hydrogen atmosphere at balloon pressure for 3 hours at room temperature. The mixture was filtered through celite and the celite was washed with methanol. The solvent was evaporated to give the desired product (210 mg, 89%). EI-MS (m/z) 281.1, 283.1 (M^-).

The following is the general procedure for urea formation

N-[4-chloro-2-hydroxy-3-[N"-(2-methoxyethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

A solution of N-(2-methoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (772 mg, 2.75 mmol) and 2,3-dichlorophenylisocyanate (560 mg, 3.03 mmol) in 2 mL of N,N-dimethylformamide was stirred at room temperature for 18 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (30/70, v/v), followed by recrystallization from acetone and hexane, gave the desired product (720 mg,

56 %). Element Analysis Theory: C 41.00%, H 3.44%, N 8.96%, Found: C 40.77%, H 3.28%, N 8.83%.

The following is the general procedure for sodium salt formation

N-[4-chloro-2-hydroxy-3-[N"-(2-methoxyethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea, sodium salt

To a solution of N-[4-chloro-2-hydroxy-3-[N"-(2-methoxyethyl)aminosulfonyl]-phenyl]-N'-(2,3-dichlorophenyl) urea (307 mg, 0.66 mmol) in 30 mL of acetone was added 1.20 mL of aq. NaOH solution (0.54 M). The mixture was stirred for 16 hours at room temperature and the solvent was evaporated. The residue was recrystallized from acetonitrile to give the desired product (288 mg, 89%). ^{1}H NMR (DMSO-d_6): δ 9.31 (s, 1H), 9.27 (s, 1H), 8.00 (d, 1H), 7.78 (d, 1H), 7.26 (m, 2H), 6.05 (d, 1H), 3.36 (t, 2H), 3.20 (s, 3H), 2.80 (m, 2H).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(2-methoxyethyl)-aminosulfonyl]phenyl] urea

Following the general procedure for urea formation outlined in example 15, N-(2-methoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (140mg, 0.50 mmol) and 2-bromophenylisocyanate (119 mg, 0.60 mmol) were coupled to form the desired urea (174 mg, 72%). EI-MS (m/z) 476.0, 478.0, 479.9 (M$^-$).

<u>Example 17</u>: Preparation of N-[4-chloro-2-hydroxy-3-(3-carboxyethylaminosulfonyl)phenyl]-N'-(2-chlorophenyl) urea.

a) N-(3-ethoxycarbonylethyl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.5 g, 5.17 mmol), β-alanine ethyl ester (0.95 mL, 6.2 mmol) and triethylamine (1.8 mL, 12.9 mmol) were reacted to form the desired product (1.8 g, 94 %). EI-MS m/z 370 (M-H)$^-$.

b) N-(3-carboxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-(3-ethoxycarbonylethyl)-2,6-dichloro-3-nitrobenzenesulfonamide (1.82 g, 4.9 mmol), NaH (60 %, 588 mg, 14.7 mmol) and water (106 mg, 5.88 mmol) were reacted to form the desired product (1.0 g, 63 %). EI-MS m/z 323.5 (M-H)$^-$.

c) N-(3-carboxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N-(3-carboxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (100 mg, 0.3 mmol) was

reduced with hydrogen and Pd/C (100 mg) to form the desired product (62 mg, 68 %). EI-MS m/z 293.5 $(M-H)^-$.

d) N-[4-chloro-2-hydroxy-3-(3-carboxyethylaminosulfonyl)phenyl]-N'-(2-bromophenyl) urea

Following the general procedure for urea formation outlined in example 15, N-(3-carboxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (62 mg, 0.21 mmol) and 2-bromophenylisocyanate (42 mg, 0.21 mmol) were coupled to form the desired urea (35 mg, 34 %). EI-MS m/z 491.7 $(M-H)^-$.

__Example 18, 19 and 20__: Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(isopropylaminosulfonyl)phenyl] urea, N-[4-chloro-2-hydroxy-3-(isopropylaminosulfonyl)phenyl]-N'-(2-chlorophenyl) urea and N-[4-chloro-2-hydroxy-3-(isopropylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea.

a) N-isopropyl-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.5 g, 5.17 mmol), isopropylamine (0.44 m, 5.17 mmol) and triethylamine (1.08 mL, 7.76 mmol) were reacted to form the desired product (1.3 g, 81 %). EI-MS m/z 312 $(M-H)^-$.

b) N-isopropyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-isopropyl-2,6-dichloro-3-nitrobenzenesulfonamide (1.3 g, 4.15 mmol), NaH (60 %, 500 mg, 12.45 mmol) and water (89 mg, 4.98 mmol) were reacted to form the desired product (0.7 g, 57 %). EI-MS m/z 293.5 $(M-H)^-$.

c) N-isopropyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N-isopropyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (0.7 g, 2.38 mmol) was reduced with hydrogen and Pd/C (0.7 g) to form the desired product (0.62 g, 98 %). EI-MS m/z 263.5 $(M-H)^-$.

d) N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(isopropylaminosulfonyl)phenyl] urea

Following the general procedure for urea formation outlined in example 15, N-isopropyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (220 mg, 0.88 mmol) and 2-

bromophenylisocyanate (174 mg, 0.88 mmol) were coupled to form the desired urea (110 mg, 29 %). EI-MS m/z 461.7 $(M-H)^-$.

e) N-[4-chloro-2-hydroxy-3-(isopropylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea. Following the general procedure for urea formation outlined in example 15, N-isopropyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (188 mg, 0.75 mmol) and 2,3-dichlorophenylisocyanate (141 mg, 0.75 mmol) were coupled to form the desired urea (104 mg, 32 %). EI-MS m/z 451.7 $(M-H)^-$.

f) N-[4-chloro-2-hydroxy-3-(isopropylaminosulfonyl)phenyl]-N'-(2-chlorophenyl) urea Following the general procedure for urea formation outlined in example 15, N-isopropyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (220 mg, 0.88 mmol) and 2-chlorophenylisocyanate (135 mg, 0.88 mmol) were coupled to form the desired urea (110 mg, 32 %). EI-MS m/z 417.1 $(M-H)^-$.

<u>Example 21</u>: N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2-methoxyphenyl) urea

Following the general procedure for urea formation outlined in example 12, 3-amino-6-chloro-2-hydroxybenzenesulfonamide (40mg, 0.18mmol) and 2-methoxyphenylisocyanate (33mg, 0.22mmol)) were coupled to form the desired urea (23mg, 34%). EI-MS (m/z) 370.3, 372.1(M^-).

<u>Example 22</u>: N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-methylenedioxyphenyl) urea

2,3-(methylenedioxy)benzoic acid

A solution of 2,3-(methylenedioxy)benzaldehyde (160mg, 1.06mmol), potassium carbonate (960mg, 6.9mmol) and 2.4mL of hydrogen peroxide (30-32 wt.% solution in water) in 10mL of methanol was stirred for 16 hours at room temperature. The mixture was washed with diethyl ether. The water layer was acidified with 1N aq. HCl to pH > 1, then extracted with ethyl acetate. The organic layer was dried over $MgSO_4$, then concentrated to give the desired product (170mg, 96%). EI-MS (m/z) 164.8 (M^-).

N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-methylenedioxyphenyl) urea

A mixture of 2,3-(methylenedioxy)benzoic acid (170mg, 1.02mmol), diphenylphosphoryl azide (338mg, 1.23mmol) and triethylamine (0.17mL, 1.23mmol) was stirred at room temperature for 3 days. The mixture was concentrated. To the residue in 1mL of N,N-dimethylformamide was added 3-amino-6-chloro-2-hydroxybenzenesulfonamide (40mg,

0.18mmol). The resulting mixture was stirred at room temperature for 16 hours. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (50/50, v/v), gave the desired product (40mg, 10%). EI-MS (m/z) 386.2, 388.2 (M^-).

Example 23: N-(2-benzyloxyphenyl)-N'-(4-chloro-2-hydroxy-3-aminosulfonylphenyl) urea

Following the general procedure for urea formation outlined in example 12, 3-amino-6-chloro-2-hydroxybenzenesulfonamide (52mg, 0.23mmol) and 2-benzyloxyphenylisocyanate (40mg, 0.17mmol) were coupled to form the desired urea (20mg, 26%). EI-MS (m/z) 446.2, 448.3, 450.2 (M^-).

Example 24: N-[3-(N''-allylaminosulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

N-allyl-2-acetyl-6-chloro-3-nitro-benzenesulfonamide

A mixture of 2-acetyl-6-chloro-3-nitrobenzenesulfonamide (150 mg, 0.51mmol), potassium carbonate (84mg, 0.61 mmol) and allyl bromide (0.18mL, 2.0mmol) in 3 mL of N,N-dimethylformamide was heated to 60°C for 4 days. The mixture was acidified with 1N aq. HCl, then extracted with ethyl acetate. The solvent was concentrated to give the crude material. Column chromatography on silica gel, eluting with ethyl acetate/hexane/acetic acid (50/49/1, v/v/v), gave the desired product (40 mg, 12%). EI-MS (m/z) 333.3, 335.2 (M^-).

N-allyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

A solution of N-allyl-2-acetyl-6-chloro-3-nitrobenzenesulfonamide (30mg, 0.09mmol), 0.1mL of chlorotrimethylsilane and 2 drops of fuming sulfuric acid in ethanol was heated to reflux for 20 hours. The solvent was evaporated. The residue was diluted with ethyl acetate and washed with water. The organic layer was then dried (Na_2SO_4) and concentrated to give the desired product (26mg, 100%). ^{1}H NMR (MeOD-d_4): δ 8.01(d, 1H), 7.20 (d, 1H), 5.70 (m, 1H), 5.16 (m, 1H), 5.05 (m, 1H), 3.62 (m, 2H).

N-allyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide

A solution of N-allyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (25mg, 0.09 mmol) and tin (II) chloride dihydrate (101mg, 0.44mmol) in 5mL of ethanol was stirred at room temperature. The mixture was concentrated, the residue was diluted with ethyl acetate and 10% aq. $NaHCO_3$. The organic layer was dried over Na_2SO_4 and concentrated to give the crude product (20mg) which was carried on to the next step without purification. EI-MS (m/z) 263.1, 265.2 (M^-).

N-[3-(N''-allylaminosulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

A solution of crude N-allyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (20mg) and 2,3-dichlorophenylisocyanate (12 µL, 0.09 mmol) in 1 mL of N,N-dimethylformamide was stirred at room temperature for 20 hours. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (30/70, v/v), gave the desired product (10 mg, 29% for two steps). EI-MS (m/z) 450.2, 452.2, 454.1 (M^-).

<u>Example 25</u>: Preparation of N-[4-chloro-2-hydroxy-3-[N''-(2-trifluoroethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

2,6-Dichloro-3-nitrobenzenesulfonic acid

Lithium hydroxide hydrate (12.64g, 0.301mol) was added to a solution of 2,6-dichlorobenzenesulfonyl chloride (35.53g, 0.146mol) in MeOH (600mL) and the reaction was allowed to stir at room temperature for 3 hr. The reaction mixture was filtered to remove suspended solids and then concentrated. The resulting solid was dried *in vacuo* overnight to remove any residual MeOH. The solid was then dissolved in H_2SO_4 (300mL) and chilled in an ice bath. A solution of H_2SO_4 (35mL) and HNO_3 (13.2mL) was slowly added to the above reaction over 90 min. The reaction was allowed to warm up to room temperature overnight and then slowly poured into ice water (1200mL) and extracted with EtOAc. The combined organic layers were dried ($MgSO_4$) and concentrated to yield 2,6-dichloro-3-nitrobenzenesulfonic acid (44.35g, 99%) as the dihydrate. EI-MS (m/z) 270 $(M-H)^-$.

2,6-Dichloro-3-nitrobenzenesulfonyl chloride

Potassium hydroxide (12.07g, 0.215mol) was added to a solution of 2,6-dichloro-3-nitrobenzenesulfonic acid dihydrate (44.35g, 0.144mol) in MeOH (850mL) and the reaction was allowed to stir at room temperature for 14 hr. The reaction mixture was concentrated and the resulting solid was dried *in vacuo* overnight. To this was added PCl_5 (30.00g, 0.144mol) followed by $POCl_3$ (475mL) and the mixture was refluxed overnight. The reaction was then cooled to room temperature and concentrated. The resulting mixture was taken up in EtOAc and chilled in an ice bath. Ice chunks were slowly added to the reaction mixture to quench any leftover PCl_5. When bubbling ceased, water was added and the reaction mix was extracted with EtOAc. The organic layer was dried ($MgSO_4$) and concentrated to yield 2,6-Dichloro-3-nitrobenzenesulfonyl chloride (40.42g, 97%). ^1H NMR (DMSO-d_6) δ 7.88 (d, 1H), 7.75 (d, 1H).

N-(2-trifluoroethyl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (560mg, 1.93mmol), 2-trifluoroethylamine hydrochloride (261mg, 1.93mmol) and triethylamine (0.89mL, 5.79mmol) were reacted to form the desired product (490mg, 72%). EI-MS (m/z) 351.1, 353.1 (M^-).

N-(2-trifluoroethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

To a solution N-(2-trifluoroethyl)-2,6-dichloro-3-nitrobenzenesulfonamide (130mg, 0.36mmol) in 5mL of tetrahydrofuran was added 60% NaH (43mg, 1.08mmol) and methanol (15μL, 0.36mmol). The mixture was stirred for 16 hours at room temperature. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane/acetic acid (49/50/1, v/v/v), gave the desired product (44mg, 33%). EI-MS (m/z) 333.1, 335.1 (M^-).

N-(2-trifluoroethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N-(2-trifluoroethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (40mg, 0.12mmol) was reduced with hydrogen and 10% Pd/C (20mg) to form the desired product (36mg, 100%). EI-MS (m/z) 303.1, 305.1 (M^-).

N-[4-chloro-2-hydroxy-3-[N"-(2-trifluoroethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N-(2-trifluoroethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (36mg, 0.12mmol) and 2,3-dichlorophenylisocyanate (27mg, 0.14mmol) were coupled to form the desired urea (23mg, 38%). ^{1}H NMR (MeOD-d_4): δ 8.28 (d, 1H), 8.05 (m, 1H), 7.24 (m, 2H), 7.05 (d, 1H), 3.79 (m, 2H).

<u>Example 26 and 27</u>: Preparation of N-(2,3-dichlorophenyl)-N'-[2-hydroxy-4-methoxy-3-(N"-phenylaminosulfonyl)phenyl] urea and N-(2-bromophenyl)-N'-[2-hydroxy-4-methoxy-3-(N"-phenylaminosulfonyl)phenyl] urea

N-phenyl-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (540mg, 1.85mmol), aniline (173mg, 1.85mmol) and triethylamine (0.61mL, 5.55mmol) were reacted to form the desired product (130mg, 20%). ^{1}H NMR (MeOD-d_4): δ 7.65 (d, 1H), 7.58 (d, 1H), 7.40 (t, 2H), 7.15 (m, 3H).

N-phenyl-2-hydroxy-6-methoxy-3-nitrobenzenesulfonamide

Following the hydrolysis procedure outlined in example 25, N-phenyl-2,6-dichloro-3-nitrobenzenesulfonamide (130mg, 0.37mmol), 60% NaH (44mg, 1.11mmol) and methanol (15μL, 0.37mmol) were reacted. The crude mixture (70mg) was carried on to the next step without purification.

N-phenyl-3-amino-2-hydroxy-6-methoxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, crude N-phenyl-2-hydroxy-6-methoxy-3-nitrobenzenesulfonamide (70mg) was reduced with hydrogen and 10% Pd/C (35mg). The crude mixture was carried on to the next step without purification.

N-(2,3-dichlorophenyl)-N'-[2-hydroxy-4-methoxy-3-(N"-phenylaminosulfonyl)-phenyl] urea

Following the general procedure for urea formation outlined in example 15, crude N-phenyl-3-amino-2-hydroxy-6-methoxybenzenesulfonamide and 2,3-dichlorophenylisocyanate (43mg, 0.23mmol) were coupled to form the desired urea (3.5mg, 4% for 3 steps). EI-MS (m/z) 480.2, 482.1 (M^-).

N-(2-bromophenyl)-N'-[2-hydroxy-4-methoxy-3-(N"-phenylaminosulfonyl)-phenyl] urea

Following the general procedure for urea formation outlined in example 15, crude N-phenyl-3-amino-2-hydroxy-6-methoxybenzenesulfonamide and 2-bromophenylisocyanate (46mg, 0.23mmol) were coupled to form the desired urea (5.0mg, 5.6%). EI-MS (m/z) 490.1, 492.1 (M^-).

<u>Example 30 and 31</u>: Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(4-morpholinylsulfonyl)phenyl] urea and N-[4-chloro-2-hydroxy-3-(4-morpholinylsulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea

2,6-dichloro-1-(4-morpholinylsulfonyl)-3-nitrobenzene

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (500 mg, 1.72 mmol), morpholine (150 mg, 1.72 mmol) and triethylamine(479 μL, 3.44 mmol) were reacted to form the desired product (430mg, 73%). LC-MS (m/z) 341.0 (M^-).

6-chloro-2-hydroxy-1-(4-morpholinylsulfonyl)-3-nitrobenzene

Following the general hydrolysis procedure outlined in example 15, 2,6-dichloro-1-(4-morpholinylsulfonyl)-3-nitrobenzene (410 mg, 1.20 mmol), 60 % NaH (144 mg, 3.6 mmol)

and water (26 µL, 1.44 mmol) were reacted to form the desired product (220 mg, 57 %). EI-MS (m/z) 321.1, 323.1 (M^-).

4-chloro-2-hydroxy-3-(4-morpholinylsulfonyl)aniline

Following the general hydrogenation procedure outlined in example 15, 6-chloro-2-hydroxy-1-(4-morpholinylsulfonyl)-3-nitrobenzene (210 mg, 0.65 mmol) was reduced with hydrogen and Pd/C (100 mg) to form the desired product (180 mg, 95 %). ^{1}H NMR (MeOD-d_4): δ 6.28 (m, 2H), 3.68 (t, 4H), 3.30 (t, 4H).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(4-morpholinylsulfonyl)phenyl] urea

Following the general procedure for urea formation outlined in example 15, 4-chloro-2-hydroxy-3-(4-morpholinylsulfonyl)aniline (90 mg, 0.31 mmol) and 2-bromophenylisocyanate(46 µL, 0.37 mmol) were coupled to form the desired urea (81mg, 53%). EI-MS (m/z) 487.76, 489.75, 491.74 (M^-).

N-[4-chloro-2-hydroxy-3-(4-morpholinylsulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, 4-chloro-2-hydroxy-3-(4-morpholinylsulfonyl)aniline (90 mg, 0.31 mmol) and 2,3-dichlorophenylisocyanate (70 µL, 0.37 mmol) were coupled to form the desired urea (77 mg, 52 %). EI-MS (m/z) 477.68, 479.72, 481.63 (M^-).

<u>Example 32 and 36</u>: Preparation of N-[3-[N"-[3-(tert-butoxycarbonylamino)-propyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea and N-[3-[N"-(3-aminopropyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate

N-[3-(tert-butoxycarbonylamino)propyl]-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.0 g, 3.44 mmol), t-butyl N-(3-aminopropyl)carbamate (0.60 mg, 3.44 mmol) and triethylamine(960 µL, 6.88 mmol) were reacted to form the desired product (1.44 g, 98 %). EI-MS (m/z) 426.1, 428.1, 430.1 $(M-H)^-$.

N-[3-(tert-butoxycarbonylamino)propyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-[3-(tert-butoxycarbonylamino)propyl]-2,6-dichloro-3-nitrobenzenesulfonamide (450 mg, 1.05 mmol), 60 % NaH (168 mg, 4.2 mmol) and water (21 µL, 1.15 mmol) were reacted to form the desired product (250 mg, 58 %). EI-MS (m/z) 408.1, 410.1 $(M-H)^-$.

N-[3-(tert-butoxycarbonylamino)propyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide
Following the general hydrogenation procedure outlined in example 15, N-[3-(tert-butoxycarbonylamino)propyl]-6-chloro-2-hydroxy-3-nitrobenzene-sulfonamide (250 mg, 0.61 mmol) was reduced with hydrogen and 10% Pd/C (100 mg) to form the desired product (220 mg, 95 %). ^{1}H NMR (MeOD-d_4): δ 6.82 (m, 2H), 3.06 (t, 2H), 2.92 (t, 2H), 1.60 (m, 2H), 1.41 (s, 9H).

N-[3-[N"-[3-(tert-butoxycarbonylamino)propyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea
Following the general procedure for urea formation outlined in example 15, N-[3-(tert-butoxycarbonylamino)propyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (110 mg, 0.29 mmol) and 2,3-dichlorophenylisocyanate (65 mg, 0.35 mmol) were coupled to form the desired urea (90 mg, 55 %). EI-MS (m/z) 565.64, 567.74, 569.60 (M^-).

The following is the general procedure for Boc deprotection
N-[3-[N"-(3-aminopropyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate
A solution of N-[3-[N"-[3-(tert-butoxycarbonylamino)propyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea (33 mg, 0.058 mmol) in 1 mL of trifluoroacetic acid was stirred at room temperature for 30 min. The solvent was concentrated. The residue was diluted with methanol, then concentrated. The process was repeated twice to give crude material. Recrystallization from methanol and water produced desired product (23 mg, 68 %). EI-MS (m/z) 466.7, 468.8, 470.8 (M^-).

<u>Example 33, 34 and 35</u>: **Preparation of N-(2-bromophenyl)-N'-[3-[N"-[3-(tert-butoxycarbonylamino) propyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea, N-[3-[N"-(3-aminopropyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2 bromophenyl) urea trifluoroacetate and N-[3-[N"-(3-aminopropyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2 bromophenyl) urea hydrochloride**
N-(2-bromophenyl)-N'-[3-[N"-[3-(tert-butoxycarbonylamino)propyl]-aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea
Following the general procedure for urea formation outlined in example 15, N-[3-(tert-butoxycarbonylamino)propyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (110 mg, 0.29 mmol) and 2-bromophenylisocyanate (69 mg, 0.35 mmol) were coupled to form the desired urea (140 mg, 84 %). EI-MS (m/z) 575.53, 577.61, 579.62 (M^-).

N-[3-[N''-(3-aminopropyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea trifluoroacetate

Following the general procedure for Boc deprotection outlined in example 36, N-(2-bromophenyl)-N'-[3-[N''-[3-(t-butoxycarbonylamino)propyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea (21 mg, 0.036 mmol) was stirred in 1 mL of trifluoroacetic acid to from the desired product (16 mg, 75 %). ^{1}H NMR (MeOD-d_4): δ 8.28 (d, 1H), 7.80 (d, 1H), 7.59 (d, 1H), 7.33 (t, 1H), 7.07 (d, 1H), 7.02 (d, 1H) 3.05 (m, 4H) 1.87 (m, 2H).

N-[3-[N''-(3-aminopropyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea hydrochloride

A solution of N-(2-bromophenyl)-N'-[3-[N''-[3-(tert-butoxycarbonylamino)-propyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea (59 mg, 0.102 mmol) in 1 mL of 4.0 M HCl in 1,4-dioxane was stirred at room temperature for 10 min. The solvent was concentrated. Recrystallization from acetone and hexane produced desired product (45 mg, 85 %). LC-MS 477.0 (M^+).

<u>Example 37 and 38</u>: **Preparation of N-(2-bromophenyl)-N'-[3-[N''-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea and N-[3-[N''-(2-aminoethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea**

t-butyl N-(2-aminoethyl)carbamate

A solution of ethylenediamine (3.0 g, 49.9 mmol), di-tert-butyl-dicarbonate (3.63 g, 16.6 mmol) and triethylamine (6.95 mL, 49.9 mmol) in 100 mL of dichloromethane was stirred at room temperature for 16 hours. The mixture was filtered to remove the solid produced during reaction. The filtrate was washed with water, dried over $MgSO_4$, concentrated and dried *in vacuo* to give the desired product (1.79g, 67 %). LC-MS 160.97 (M^+).

N-[2-(tert-butoxycarbonylamino)ethyl]-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.0g, 3.44mmol), t-butyl N-(2-aminoethyl)carbamate (0.5 g, 3.44mmol) and triethylamine(0.72 mL, 5.16mmol) were reacted to form the desired product (1.29g, 90%). ^{1}H NMR (MeOD-d_4): δ 7.93 (d, 1H), 7.78 (d, 1H), 3.12 (m, 4H), 1.41 (s, 9H).

N-[2-(tert-butoxycarbonylamino)ethyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-[2-(tert-butoxycarbonylamino)ethyl]-2,6-dichloro-3-nitrobenzenesulfonamide (1.63 g, 3.94 mmol),

60 % NaH (630 mg, 15.8 mmol) and water (71 µL, 3.94 mmol) were reacted to form the desired product (200 mg, 13 %). [1]H NMR (MeOD-d_4): δ 8.10 (d, 1H), 7.21 (d, 1H), 3.15 (t, 2H), 3.08 (t, 2H), 1.41 (s, 9H).

N-[2-(tert-butoxycarbonylamino)ethyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide
Following the general hydrogenation procedure outlined in example 15, N-[2-(tert-butoxycarbonylamino)ethyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (200 mg, 0.51mmol) was reduced with hydrogen and 10 % Pd/C (100 mg) to form the desired product (170 mg, 92 %). [1]H NMR (MeOD-d_4): δ 6.84 (m, 2H), 3.15 (t, 2H), 2.95 (t, 2H), 1.42 (s, 9H).

N-(2-bromophenyl)-N'-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]-aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea
Following the general procedure for urea formation outlined in example 15, N-[2-(tert-butoxycarbonylamino)ethyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (170 mg, 0.47 mmol) and 2-bromophenylisocyanate (92 mg, 0.47 mmol) were coupled to form the desired urea (120mg, 49%). LC-MS 565.0 (M^+).

N-[3-[N"-(2-aminoethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2- bromophenyl) urea trifluoroacetate
Following the general procedure for Boc deprotection outlined in example 36, N-(2-bromophenyl)-N'-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea (80 mg, 0.14 mmol) was stirred in trifluoroacetic acid to form the desired product (22mg, 34%). LC-MS 465.0 (M^+).

<u>Example 39 and 42</u>: **Preparation of N-(2-bromophenyl)-N'-[3-[[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl]-4-chloro-2-hydroxyphenyl] urea and N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(piperazin-1-yl)sulfonylphenyl] urea trifluoroacetate**

1-[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl-2,6-dichloro-3-nitrobenzene
Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (500 mg, 1.72 mmol), tert-butyl 1-piperazinecarboxylate (320 mg, 1.72 mmol) and triethylamine (479 µL, 3.44 mmol) were reacted to form the desired product (650 mg, 84%). LC-MS (m/z) 440.2 (M^+).

1-[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl-6-chloro-2-hydroxy-3-nitrobenzene

Following the general hydrolysis procedure outlined in example 15, 1-[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl-2,6-dichloro-3-nitrobenzene (200mg, 0.45mmol), 60 % NaH (54mg, 1.35mmol) and water (8µL, 0.45 mmol) were reacted to form the desired product (60mg, 32%). EI-MS (m/z) 420.1, 422.1 (M^+).

3-[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl-4-chloro-2-hydroxyaniline
Following the general hydrogenation procedure outlined in example 15, 1-[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl-6-chloro-2-hydroxy-3-nitrobenzene (256mg, 0.61mmol) was reduced with hydrogen and 10% Pd/C (120mg) to form the desired product (220mg, 93%). ^{1}H NMR (MeOD-d_4): δ 6.84 (m, 2H), 3.45 (m, 4H), 3.27 (m, 4H), 1.43 (s, 9H).

N-(2-bromophenyl)-N'-[3-[[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl]-4-chloro-2-hydroxyphenyl] urea
Following the general procedure for urea formation outlined in example 15, 3-[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl-4-chloro-2-hydroxyaniline (110mg, 0.28mmol) and 2-bromophenylisocyanate (67mg, 0.34mmol) were coupled to form the desired urea (60mg, 36%). Element Analysis Theory: C 44.80%, H 4.44%, N 9.50%, Found: C 44.65%, H 4.15%, N 9.20%.

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(piperazin-1-yl)sulfonylphenyl] urea trifluoroacetate
Following the general procedure for Boc deprotection outlined in example 36, N-(2-bromophenyl)-N'-[3-[[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl]-4-chloro-2-hydroxyphenyl] urea (10 mg, 0.019 mmol) was stirred in trifluoroacetic acid to form the desired product (5mg, 49 %). ^{1}H NMR (MeOD-d_4): δ 8.28 (d, 1H), 7.91 (d, 1H), 7.60 (d, 1H), 7.33 (t, 1H), 7.14 (d, 1H), 7.02 (d, 1H) 3.64 (t, 4H) 3.33 (m, 4H).

<u>Example 40 and 41</u>: **Preparation N-[3-[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea and N-[4-chloro-2-hydroxy-3-(piperazin-1-yl)sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate**
N-[3-[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea
Following the general procedure for urea formation outlined in example 15, 3-[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl-4-chloro-2-hydroxyaniline (110mg, 0.28mmol) and 2,3-dichlorophenylisocyanate (64mg, 0.34mmol) were coupled to form the desired urea (34mg, 25%). EI-MS (m/z) 576.65, 578.65, 580.67 (M^-).

N-[4-chloro-2-hydroxy-3-(piperazin-1-yl)sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate

Following the general procedure for Boc deprotection outlined in example 36, N-[3-[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea (20 mg, 0.034 mmol) was stirred in trifluoroacetic acid to form the desired product (13.5 mg, 66 %). EI-MS (m/z) 481.7, 483.7, 485.7 (M^+).

<u>Example 43, 51 and 60</u>: Preparation of N-[4-chloro-2-hydroxy-3-[N"-(3-methylthiopropyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea, N-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfonyl)propyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea, and N-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfinyl)propyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

N-(3-methylthiopropyl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (2g, 6.88mmol), 3-(methylthio)propylamine (0.72g, 6.88mmol) and triethylamine (1.92mL, 13.76mmol) were reacted to form the desired product (2.07g, 82%). ^{1}H NMR (MeOD-d_4): δ 7.93 (d, 1H), 7.79 (d, 1H), 3.16 (t, 2H), 2.47 (t, 2H), 2.00 (s, 3H), 1.76 (m, 2H).

N-(3-methylthiopropyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-(3-methylthiopropyl)-2,6-dichloro-3-nitrobenzenesulfonamide (1.0g, 2.78mmol), 60% NaH (330mg, 8.13mmol) and water (59μL, 3.25mmol) were reacted to form the desired product (650mg, 69%). EI-MS (m/z) 339.86, 341.84 (M^-).

N-(3-methylthiopropyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N-(3-methylthiopropyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (300mg, 0.88mmol) was reduced with hydrogen and 10% Pd/C (150mg) to form the desired product (250mg, 91%). ^{1}H NMR (MeOD-d_4): δ 6.84 (d, 1H), 6.77 (d, 1H), 2.93 (t, 2H), 2.40 (t, 2H), 1.89 (s, 3H), 1.63 (m, 2H).

N-[4-chloro-2-hydroxy-3-[N"-(3-methylthiopropyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N-(3-methylthiopropyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (250mg, 0.80mmol)

and 2,3-dichlorophenylisocyanate (182mg, 0.97mmol) were coupled to form the desired urea (278mg, 70%). ^{1}H NMR (MeOD-d_4): δ 8.29 (d, 1H), 8.06 (d, 1H), 7.24 (m, 2H), 7.05 (d, 1H), 3.07 (t, 2H), 2.48 (t, 2H), 1.98 (s, 3H) 1.74 (m, 2H).

N-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfonyl)propyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

A solution of N-[4-chloro-2-hydroxy-3-[N"-(3-methylthiopropyl)aminosulfonyl]-phenyl]-N'-(2,3-dichlorophenyl) urea (50mg, 0.10mmol) and oxone (93mg, 0.15mmol) in acetonitrile (13mL) and water (7 mL) was stirred for 3 days at room temperature. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane/acetic acid (49/50/1, v/v/v), followed by recrystallization from acetone and hexane, gave the desired product (46mg, 87%). EI-MS (m/z) 527.53, 529.57, 531.55 (M^+).

N-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfinyl)propyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

A solution of N-[4-chloro-2-hydroxy-3-[N"-(3-methylthiopropyl)aminosulfonyl]-phenyl]-N'-(2,3-dichlorophenyl) urea (50mg, 0.10mmol) and sodium periodate (26mg, 0.12mmol) in acetonitrile (6mL) and water (2 mL) was stirred for 3 days at room temperature. The mixture was diluted with ethyl acetate and washed with water to give the crude material. Recrystallization from acetone and hexane gave the desired product (42mg, 81%). ^{1}H NMR (DMSO-d_6): δ 9.32 (s, 1H), 9.27 (s, 1H), 8.59 (s, 1H), 8.29 (d, 1H), 8.07 (m, 1H), 7.33 (m, 2H), 7.13 (d, 1H), 3.00 (m, 2H), 2.75 (m, 1H), 2.65 (m, 1H), 2.47 (s, 3H), 1.79 (m, 2H).

<u>Example 44, 52 and 61</u>: **Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(3-methylthiopropyl)aminosulfonyl]phenyl] urea, N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfonyl)propyl]-aminosulfonyl]phenyl] urea and N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfinyl)propyl]aminosulfonyl]phenyl] urea**

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(3-methylthiopropyl)-aminosulfonyl]phenyl] urea

Following the general procedure for urea formation outlined in example 15, N-(3-methylthiopropyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (250mg, 0.80mmol) and 2-bromophenylisocyanate (191mg, 0.97mmol) were coupled to form the desired urea (300mg, 74%). ^{1}H NMR (MeOD-d_4): δ 8.28 (d, 1H), 7.91 (d, 1H), 7.58 (d, 1H), 7.32 (t, 1H), 7.05 (d, 1H), 7.00 (t, 1H), 3.08 (t, 2H), 2.48 (t, 2H), 1.98 (s, 3H), 1.74 (m, 2H).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfonyl)propyl]-aminosulfonyl]phenyl] urea

Following the oxidation procedure outlined in example 51, N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(3-methylthiopropyl)aminosulfonyl]phenyl] urea (50mg, 0.10mmol) and oxone (91mg, 0.15mmol) were reacted to give the desired product (41mg, 77%). Element Analysis Fond: C 37.58%, H 3.37%, N 7.59%, Theory: C 37.75%, H 3.54%, N 7.77%.

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfinyl)propyl]-aminosulfonyl]phenyl] urea

Following the oxidation procedure outlined in example 61, N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(3-methylthiopropyl)-aminosulfonyl]phenyl] urea (50mg, 0.10mmol) and sodium periodate (25mg, 0.12mmol) were reacted to give the desired product (8mg, 16%). LC-MS 526.0 (M^+).

<u>Example 47, 58, 48 and 59</u>: Preparation of N-(2-bromophenyl)-N'-[4-chloro-3-[N",N"-di-(2-methoxyethyl)aminosulfonyl]-2-hydroxyphenyl] urea, N-(2-bromophenyl)-N'-[4-chloro-3-[N",N"-di-(2-hydroxyethyl)aminosulfonyl]-2-hydroxyphenyl] urea, N-[4-chloro-3-[N",N"-di-(2-methoxyethyl)-aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea and N-[4-chloro-3-[N",N"-di-(2-hydroxyethyl)aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

N,N-di-(2-methoxyethyl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.82g, 6.26mmol), bis(2-methoxyethyl)amine (830mg, 6.26mmol) and triethylamine(1.7mL, 12.52mmol) were reacted to form the desired product (2.16g, 89%). LC-MS (m/z) 387.2 (M^+).

N,N-di-(2-methoxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N,N-di-(2-methoxyethyl)-2,6-dichloro-3-nitrobenzenesulfonamide (800mg, 2.07mmol), 60% NaH (248mg, 6.21mmol) and water (45µL, 2.48mmol) were reacted to form the desired product (420mg, 55%). EI-MS (m/z) 366.89, 368.81 (M^-).

N,N-di-(2-methoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N,N-di-(2-methoxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (100mg, 0.27mmol) was

reduced with hydrogen and 10 % Pd/C (50mg) to form the desired product (80mg, 87%). ^{1}H NMR (MeOD-d_4): δ 6.85 (m, 2H), 3.58 (t, 4H), 3.47 (t, 4H), 3.21 (s, 6H).

N-(2-bromophenyl)-N'-[4-chloro-3-[N",N"-di-(2-methoxyethyl)aminosulfonyl]-2-hydroxyphenyl] urea

Following the general procedure for urea formation outlined in example 15, N,N-di-(2-methoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (40mg, 0.12mmol) and 2-bromophenylisocyanate (23mg, 0.12mmol) were coupled to form the desired urea (39mg, 61%). EI-MS (m/z) 534.6, 536.6 (M^-)

N-(2-bromophenyl)-N'-[4-chloro-3-[N",N"-di-(2-hydroxyethyl)aminosulfonyl]-2-hydroxyphenyl] urea

A solution of N-(2-bromophenyl)-N'-[4-chloro-3-[N",N"-di-(2-methoxyethyl)-aminosulfonyl]-2-hydroxyphenyl] urea (9.9mg, 0.018mmol) and aluminum bromide (4.2mg, 0.018mmol) in 2 mL of ethanethio was stirred for 16 hours at room temperature. The mixture was concentrated. The residue was diluted with ethyl acetate, then washed with 1N aq. HCl, the organic layer was dried over $MgSO_4$ and concentrated. Recrystallization from acetone and methanol gave the desired product (4mg, 44%). ^{1}H NMR (MeOD-d_4): δ 8.30 (d, 1H), 7.92 (d 1H), 7.59 (d, 1H), 7.33 (t, 1H), 7.07 (d, 1H), 7.01 (t, 1H), 3.68 (t, 4H), 3.51 (m, 4H).

N-[4-chloro-3-[N",N"-di-(2-methoxyethyl)aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N,N-di-(2-methoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (40mg, 0.12mmol) and 2,3-dichlorophenylisocyanate (22mg, 0.12mmol) were coupled to form the desired urea (55mg, 87%). ^{1}H NMR (MeOD-d_4): δ 8.27 (m, 1H), 8.03 (m, 1H), 7.23 (m, 2H), 7.03 (m, 1H), 3.61 (m, 4H), 3.45 (m, 4H), 3.23 (s, 6H).

N-[4-chloro-3-[N",N"-di-(2-hydroxyethyl)aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

Following the deprotection procedure outlined in example 58, N-[4-chloro-3-[N",N"-di-(2-methoxyethyl)aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea (15mg, 0.028mmol) and aluminum bromide (18.7mg, 0.07mmol) were reacted to give the desired product (2mg, 14%). LC-MS 500.0 (M^+).

Example 49 and 50: Preparation of N-(2-bromophenyl)-N'-[4-chloro-3-[N"-[2-(dimethylamino)ethyl]aminosulfonyl]-2-hydroxyphenyl] urea hydrochloride and N-[4-chloro-3-[N"-[2-(dimethylamino)ethyl]-aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride

N-[2-(dimethylamino)ethyl]-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (400mg, 1.38mmol), N,N-dimethylethylenediamine (121mg, 1.38mmol) and triethylamine(0.39mL, 2.76mmol) were reacted to form the crude product (480mg) which was carried on to the hydrolysis without purification.. EI-MS (m/z) 341.88 (M^-).

N-[2-(dimethylamino)ethyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, crude N-[2-(dimethylamino)ethyl]-2,6-dichloro-3-nitrobenzenesulfonamide (480mg), 60% NaH (168mg, 4.2mmol) and water (25µL, 1.4mmol) were reacted. The crude product (80mg) was carried on to the next step without purification. EI-MS (m/z) 321.98, 323.96 (M^-).

N-[2-(dimethylamino)ethyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, crude N-[2-(dimethylamino)ethyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (80mg) was reduced with hydrogen and 10 % Pd/C (40mg) to form the crude product (70mg) which was carried on to form urea without purification.

N-(2-bromophenyl)-N'-[4-chloro-3-[N"-[2-(dimethylamino)ethyl]aminosulfonyl]-2-hydroxyphenyl] urea hydrochloride

Following the general procedure for urea formation outlined in example 15, crude N-[2-(dimethylamino)ethyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (35mg) and 2-bromophenylisocyanate (28mg, 0.14mmol) were coupled to form the desired urea (12mg, 20% for four steps). EI-MS (m/z) 490.7, 492.7, 494.7 (M^+).

N-[4-chloro-3-[N"-[2-(dimethylamino)ethyl]aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride

Following the general procedure for urea formation outlined in example 15, crude N-[2-(dimethylamino)ethyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (35mg) and 2,3-dichlorophenylisocyanate (26mg, 0.14mmol) were coupled to form the desired urea (5.8mg, 10% for four steps). EI-MS (m/z) 482.80, 484.78 (M^+).

Example 53, 54 and 55: Preparation of N-[4-chloro-2-hydroxy-3-[N"-[2-(morpholinyl)ethyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride, N-[4-chloro-2-hydroxy-3-[N"-[2-(morpholinyl)ethyl]-aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea hydrochloride and N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[2-(4-morpholinyl)ethyl]-aminosulfonyl]phenyl] urea

N-[2-(morpholinyl)ethyl]-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (600mg, 2.07mmol), 4-(2-aminoethyl) morpholine (269mg, 2.07mmol) and triethylamine (0.58mL, 4.13mmol) were reacted to form the desired product (593mg, 75%). LC-MS (m/z) 384.0 (M^+).

N-[2-(morpholinyl)ethyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-[2-(morpholinyl)ethyl]-2,6-dichloro-3-nitrobenzenesulfonamide (400mg, 1.04mmol), 60% NaH (125mg, 3.12mmol) and water (23μL, 1.25mmol) were reacted to form the crude product (600mg) which was carried onto the hydrogenation without purification. EI-MS (m/z) 363.95, 365.94 (M^-).

N-[2-(morpholinyl)ethyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, crude N-[2-(morpholinyl)ethyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (300mg) was reduced with hydrogen and 10 % Pd/C (80mg) to form the crude product (300mg) which was carried onto the urea step without purification. EI-MS (m/z) 338.93, 340.98 (M^+).

N-[4-chloro-2-hydroxy-3-[N"-[2-(morpholinyl)ethyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride

Following the general procedure for urea formation outlined in example 15, crude N-[2-(morpholinyl)ethyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (150mg) and 2,3-dichlorophenylisocyanate (49mg, 0.26mmol) were coupled to form the desired urea (23mg, 15% for 3 steps). EI-MS (m/z) 522.72, 524.65, 526.70 (M^+).

N-[4-chloro-2-hydroxy-3-[N"-[2-(morpholinyl)ethyl]aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea hydrochloride

Following the general procedure for urea formation outlined in example 15, crude N-[2-(morpholinyl)ethyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (183mg) and 2-

chlorophenylisocyanate (40mg, 0.26mmol) were coupled to form the desired urea (50mg, 39% for 3 steps). LC-MS 489.2 (M^+).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[2-(4-morpholinyl)ethyl]aminosulfonyl]phenyl] urea
Following the general procedure for urea formation outlined in example 15, N-[2-(morpholinyl)ethyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (150mg) and 2-bromophenylisocyanate (51mg, 0.26mmol) were coupled to form the desired urea (10mg, 7% for 3 steps). EI-MS (m/z) 535.64, 537.56, 539.61 (M^+).

<u>Example 56 and 57</u>: Preparation of N-[4-chloro-2-hydroxy-3-(4-thiomorpholinylsufonyl)phenyl]-N'-(2,3-dichlorophenyl) urea and N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(4-thiomorpholinylsulfonyl)phenyl] urea
2,6-dichloro-3-nitro-1-(4-thiomorpholinylsufonyl)benzene
Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (2.0g, 6.88mmol), thiomorpholine (710mg, 6.88mmol) and triethylamine(1.92mL, 13.76mmol) were reacted to form the desired product (2.30g, 94%). ^{1}H NMR (MeOD-d_4): δ 7.95 (d, 1H), 7.85(d, 1H), 3.68 (t, 4H), 2.69 (t, 4H).

6-chloro-2-hydroxy-3-nitro-1-(4-thiomorpholinylsufonyl)benzene
Following the general hydrolysis procedure outlined in example 15, 2,6-dichloro-3-nitro-1-(4-thiomorpholinylsufonyl)benzene (1.04g, 2.91mmol), 60% NaH (349mg, 8.73mmol) and water (63μL, 3.50mmol) were reacted to form the desired product (330mg, 33%). EI-MS (m/z) 336.89, 338.93 (M^-).

4-chloro-2-hydroxy-3-(4-thiomorpholinylsufonyl)aniline
Following the general hydrogenation procedure outlined in example 15, 6-chloro-2-hydroxy-3-nitro-1-(4-thiomorpholinylsufonyl)benzene (330mg, 0.97mmol) was reduced with hydrogen and 10 % Pd/C (150mg) to form the desired product (240mg, 80%). ^{1}H NMR (MeOD-d_4): δ 7.08 (d, 1H), 6.98(d, 1H), 3.59 (t, 4H), 2.68 (t, 4H).

N-[4-chloro-2-hydroxy-3-(4-thiomorpholinylsufonyl)phenyl]-N'-(2,3-dichlorophenyl) urea
Following the general procedure for urea formation outlined in example 15, 4-chloro-2-hydroxy-3-(4-thiomorpholinylsufonyl)aniline (120mg, 0.36mmol) and 2,3-dichlorophenylisocyanate(68mg, 0.36mmol) were coupled to form the desired urea (50mg,

28%). ^{1}H NMR (MeOD-d_4): δ 8.31 (m, 1H), 8.05 (m, 1H), 7.26 (m, 2H), 7.08 (m, 1H), 3.61 (m, 4H), 2.69 (m, 4H).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(4-thiomorpholinylsulfonyl)-phenyl] urea
Following the general procedure for urea formation outlined in example 15, 4-chloro-2-hydroxy-3-(4-thiomorpholinylsufonyl)aniline (120mg, 0.26mmol) and 2-bromophenylisocyanate (72mg, 0.36mmol) were coupled to form the desired urea (110mg, 60%). ^{1}H NMR (DMSO-d_6): δ 9.25 (s, 1H), 8.98 (s, 1H), 8.34 (d, 1H), 7.92 (d, 1H), 7.65 (d, 1H) 7.35 (t, 1H), 7.19 (d, 1H), 7.01 (t, 1H), 3.54 (t, 4H), 2.67 (t, 4H).

<u>Example 45:</u> **N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea potasium salt:** The general procedure outlined in example 15 was followed to give N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea potasium salt; ^{1}H NMR (DMSO-d_6): δ 9.27 (s, 2H), 8.01 (m, 3H), 7.81 (d, 1H), 7.26 (m, 2H), 6.15 (m, 1H).

<u>Example 46:</u> **N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea sodium salt:** The general procedure outlined in example 15 was followed to give N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea sodium salt; ^{1}H NMR (DMSO-d_6): δ 9.27 (s, 2H), 8.01 (m, 3H), 7.77 (d, 1H), 7.26 (m, 2H), 6.05 (d, 1H).

<u>Example 62, 67, 63 and 66</u>: **Preparation of N-(2-bromophenyl)-N'-[3-[N''-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea, N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N''-[(piperidin-4-yl)methyl]aminosulfonyl]phenyl] urea hydrochloride, N-[3-[N''-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea and N-[4-chloro-2-hydroxy-3-[N''-[(piperidin-4-yl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate**

N-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]-2,6-dichloro-3-nitrobenzenesulfonamide
Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.2g, 4.13mmol), N-(tert-butoxycarbonyl)-4-aminomethyl piperidine (0.88g, 4.13mmol) and triethylamine(0.86mL, 6.20mmol) were reacted to form the desired product (1.52g, 79%). LC-MS (m/z) 468.2 (M^+).

N-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]-2,6-dichloro-3-nitrobenzenesulfonamide (800mg, 1.89mmol), 60% NaH (227mg, 5.67mmol) and water (41μL, 2.27mmol) were reacted to form the desired product (495mg, 58%). EI-MS (m/z) 447.92, 449.84 (M^-).

N-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (480mg, 1.07mmol) was reduced with hydrogen and 10% Pd/C (240mg). The crude product (460mg) was carried on to the next step without purification. ^{1}H NMR (MeOD-d_4): δ 6.86 (m, 2H), 4.00 (d, 2H), 2.83 (m, 2H), 2.78 (m, 2H), 1.60 (m, 3 H), 1.44 (s, 9H), 1.00 (m, 2H).

N-(2-bromophenyl)-N'-[3-[N"-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea

Following the general procedure for urea formation outlined in example 15, crude N-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (230mg) and 2-bromophenylisocyanate (129mg, 0.65mmol) were coupled to form the desired urea (110mg, 30% for two steps). LC-MS (m/z) 619.0 (M^+).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[(piperidin-4-yl)methyl]aminosulfonyl]phenyl] urea hydrochloride

A solution of N-(2-bromophenyl)-N'-[3-[N"-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea (27mg, 0.044mmol) in 1.0mL of 4.0N HCl in 1,4-dioxane was stirred at room temperature for 10 min. The mixture was concentrated. Recrystallization from acetone and hexane gave desired product (16mg, 65%). LC-MS (m/z) 519.2 (M^+).

N-[3-[N"-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, crude N-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (230mg) and 2,3-dichlorophenylisocyanate (122mg, 0.65mmol) were coupled to form the desired urea (100mg, 29% for two steps). ^{1}H NMR (MeOD-d_4): δ 8.29 (d, 1H), 8.05 (m, 1H), 7.25 (m, 2H), 7.06 (d, 1H), 4.35 (d, 2H), 2.83 (m, 2H), 2.49 (m, 2H), 1.69 (m, 3H), 1.43 (s, 9H), 1.00 (m, 2H).

N-[4-chloro-2-hydroxy-3-[N"-[(piperidin-4-yl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate

Following the general procedure for Boc deprotection outlined in example 36, N-[3-[N"-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea (20 mg, 0.033mmol) was stirred in trifluoroacetic acid to form the desired product (9 mg, 44%). LC-MS (m/z) 509.0 (M^+).

__Example 64, 140, 65 and 141__: Preparation of N-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea, N-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea sodium salt, N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl] urea and N-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl]-N'-(2-chlorophenyl) urea

6-chloro-2-hydroxy-3-nitro-1-(1-oxidothiomorpholinosufonyl)benzene

A solution of 6-chloro-2-hydroxy-3-nitro-1-(4-thiomorpholinylsufonyl)benzene (100mg, 0.30mmol) and sodium periodate (95mg, 0.44mmol) in acetonitrile (10mL) and water (2 mL) was stirred for 3 days at room temperature. The mixture was diluted with ethyl acetate and washed with water, dried over $MgSO_4$ and concentrated to give the desired product (106.4mg, 100%). EI-MS (m/z) 352.89, 354.87 (M^-).

4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosufonyl)aniline

Following the general hydrogenation procedure outlined in example 15, 6-chloro-2-hydroxy-3-nitro-1-(1-oxidothiomorpholinosufonyl)benzene (103mg, 0.29mmol) was reduced with hydrogen and 10% Pd/C (59mg) to form the desired product (89mg, 95%). LC-MS (m/z) 325.0 (M^+).

N-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, 4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosufonyl)aniline (117mg, 0.35mmol) and 2,3-dichlorophenylisocyanate (72mg, 0.38mmol) were coupled to form the desired urea (79mg, 44%). ^{1}H NMR (DMSO-d_6): δ 9.34 (s, 1H), 9.27 (s, 1H), 8.28 (d, 1H), 8.05 (m, 1H), 7.32 (m, 2H), 7.21 (d, 1H), 3.75 (m, 2H), 3.65 (m, 2H), 2.89, (m, 4H).

N-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea sodium salt

Following the general procedure for salt formation outlined in example 15, N-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea (275mg, 0.53mmol) and 0.50N aq. NaOH (1.06mL, 0.53mmol) was reacted to give the desired sodium slat (250mg, 87%). ^{1}H NMR (DMSO-d_6): δ 9.30 (s, 2H), 8.00 (d, 1H), 7.67 (d, 1H), 7.25 (m, 2H), 5.89 (d, 1H), 3.68 (m., 4H), 2.90 (t, 2H), 2.75 (t, 3H).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)-phenyl] urea

Following the general procedure for urea formation outlined in example 15, 4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosufonyl)aniline (88mg, 0.27mmol) and 2-bromophenylisocyanate (65mg, 0.33mmol) were coupled to form the desired urea (65mg, 46%). LC-MS (m/z) 524.2 (M$^+$).

N-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl]-N'-(2-chlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, 4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosufonyl)aniline (117mg, 0.35mmol) and 2-chlorophenylisocyanate (58mg, 0.28mmol) were coupled to form the desired urea (58mg, 35%). LC-MS (m/z) 478.0 (M$^+$).

<u>Example 68, 69 and 70</u>: Preparation of N-[3-(1-azetidinylsulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea, N-[3-(1-azetidinylsulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea and N-[3-(1-azetidinylsulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

1-(azetidin-1-yl)sulfonyl-2,6-dichloro-3-nitrobenzene

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.0g, 3.44mmol), azetidine hydrochloride (320mg, 3.44mmol) and triethylamine(1.44mL, 10.32mmol) were reacted to form the desired product (510mg, 48%). ^{1}H NMR (MeOD-d_4): δ 7.94 (d, 1H), 7.79 (d, 1H), 4.16 (t, 4H), 2.29 (m, 2H).

1-(azetidin-1-yl)sulfonyl-6-chloro-2-hydroxy-3-nitrobenzene

Following the general hydrolysis procedure outlined in example 15, 1-(azetidin-1-yl)sulfonyl-2,6-dichloro-3-nitrobenzene (510mg, 1.64mmol), 60% NaH (197mg, 4.92mmol) and water (35μL, 1.97mmol) were reacted to form the desired product (240mg, 50%). ^{1}H NMR (MeOD-d_4): δ 8.09 (d, 1H), 7.25 (d, 1H), 4.15 (t, 4H), 2.29 (m, 2H).

3-(azetidin-1-yl)sulfonyl-4-chloro-2-hydroxyaniline

Following the general hydrogenation procedure outlined in example 15, 1-(azetidin-1-yl)sulfonyl-6-chloro-2-hydroxy-3-nitrobenzene (240mg, 0.82mmol) was reduced with hydrogen and 10 % Pd/C (110mg) to form the desired product (215mg, 100%). ^{1}H NMR (MeOD-d_4): δ 6.91 (m, 2H), 4.01 (t, 4H), 2.23 (m, 2H).

N-[3-(1-azetidinylsulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea Following the general procedure for urea formation outlined in example 15, 3-(azetidin-1-yl)sulfonyl-4-chloro-2-hydroxyaniline (215mg, 0.82mmol) and 2-bromophenylisocyanate (195mg, 0.98mmol) were coupled to form the desired urea (69mg, 18%). LC-MS 462.0 (M^+).

N-[3-(1-azetidinylsulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea Following the general procedure for urea formation outlined in example 15, 3-(azetidin-1-yl)sulfonyl-4-chloro-2-hydroxyaniline (235mg, 0.9mmol) and 2-chlorophenylisocyanate (134mg, 0.9mmol) were coupled to form the desired urea (200mg, 54%). LC-MS 416.0 (M^+).

N-[3-(1-azetidinylsulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea Following the general procedure for urea formation outlined in example 15, 3-(azetidin-1-yl)sulfonyl-4-chloro-2-hydroxyaniline (235mg, 0.9mmol) and 2,3-dichlorophenylisocyanate (169mg, 0.9mmol) were coupled to form the desired urea (160mg, 40%). LC-MS 450.0 (M^+).

Example 71: N-(2-bromophenyl)-N'-[4-chloro-3-(N",N"-dimethylaminosulfonyl)-2-hydroxyphenyl] urea potassium salt: The general procedure outlined in example 15 was followed to give N-(2-bromophenyl)-N'-[4-chloro-3-(N",N"-dimethylaminosulfonyl)-2-hydroxyphenyl] urea potassium salt; ^{1}H NMR (DMSO-d_6): δ 9.20 (s, 1H), 8.99 (s, 1H), 7.82 (d, 1H), 7.66 (d, 1H), 7.57 (d, 1H), 7.29 (t, 1H), 6.95 (t, 1H), 5.93 (d, 1H), 2.83 (s, 6H).

Example 72: N-(2-bromophenyl)-N'-[4-chloro-3-(N",N"-dimethylaminosulfonyl)-2-hydroxyphenyl] urea sodium salt: The general procedure outlined in example 15 was followed to give N-(2-bromophenyl)-N'-[4-chloro-3-(N",N"-dimethylaminosulfonyl)-2-hydroxyphenyl] urea sodium salt; Element Analysis Theory (1.25 eq. water): C 36.53%, H 3.37%, N 8.52%, Na 4.66%, Found: C 36.32%, H 3.34%, N 8.38%, Na 4.69%.

Example 73, 74 and 75: Preparation of N-(2-bromophenyl)-N'-[4-chloro-3-(N"-cyclopropylaminosulfonyl)-2-hydroxyphenyl) urea, N-[4-chloro-3-(N"-cyclopropylaminosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea and N-[4-

chloro-3-(N''-cyclopropylaminosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

N-cyclopropyl-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.39g, 4.78mmol), cyclopropylamine (273mg, 4.78mmol) and triethylamine(1.0mL, 7.17mmol) were reacted to form the desired product (1.15g, 77%). ^{1}H NMR (MeOD-d_4): δ 7.72 (d, 1H), 7.65 (d, 1H), 2.34 (m, 1H), 0.75 (m, 4H).

N-cyclopropyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-cyclopropyl-2,6-dichloro-3-nitrobenzenesulfonamide (1.15g, 3.70mmol), 60% NaH (444mg, 11.1mmol) and water (67µL, 3.70mmol) were reacted to form the desired product (740mg, 68%). ^{1}H NMR (MeOD-d_4): δ 8.06 (d, 1H), 7.24 (d, 1H), 2.29 (m, 1H), 0.60 (m, 4H).

N-cyclopropyl -3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N-cyclopropyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (740mg, 2.53mmol) was reduced with hydrogen and 10% Pd/C (350mg) to form the desired product (660mg, 99%). ^{1}H NMR (MeOD-d_4): δ 6.83 (m, 2H), 2.20 (m, 1H), 0.56 (m, 4H).

N-(2-bromophenyl)-N'-[4-chloro-3-(N''-cyclopropylaminosulfonyl)-2-hydroxyphenyl) urea

Following the general procedure for urea formation outlined in example 15, N-cyclopropyl -3-amino-6-chloro-2-hydroxybenzenesulfonamide (220mg, 0.84mmol) and 2-bromophenylisocyanate (199mg, 1.01mmol) were coupled to form the desired urea (135mg, 35%). LC-MS (m/z) 462.0 (M^+).

N-[4-chloro-3-(N''-cyclopropylaminosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N-cyclopropyl -3-amino-6-chloro-2-hydroxybenzenesulfonamide (220mg, 0.84mmol) and 2-chlorophenylisocyanate (155mg, 1.01mmol) were coupled to form the desired urea (150mg, 43%). LC-MS (m/) 416.2 (M^+).

N-[4-chloro-3-(N''-cyclopropylaminosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N-cyclopropyl -3-amino-6-chloro-2-hydroxybenzenesulfonamide (220mg, 0.84mmol) and 2,3-

dichlorophenylisocyanate (190mg, 1.01mmol) were coupled to form the desired urea (176mg, 46%). LC-MS (m/z) 452.0 (M^+).

<u>Example 76, 77 and 78</u>: Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-propylaminosulfonyl)phenyl] urea, N-[4-chloro-2-hydroxy-3-(N"-propylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea and N-[4-chloro-2-hydroxyl-3-(N"-propylaminosulfonyl)phenyl]-N'-(2-chlorophenyl) urea

N-propyl-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.3g, 4.48mmol), propylamine (264mg, 4.48mmol) and triethylamine(0.94mL, 6.72mmol) were reacted to form the desired product (1.0g, 71%). ^{1}H NMR (MeOD-d_4): δ 7.92 (d, 1H), 7.78 (d, 1H), 3.00 (t, 2H), 1.50 (m, 2H), 0.88 (t, 3H).

N-propyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-propyl-2,6-dichloro-3-nitrobenzenesulfonamide (1.0g, 3.19mmol), 60% NaH (393mg, 3.19mmol) and water (58µL, 3.19mmol) were reacted to form the desired product (650mg, 69%). LC-MS (m/z) 295.0 (M^+).

N-propyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N-propyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (650mg, 2.2mmol) was reduced with hydrogen and 10% Pd/C (320mg) to form the desired product (560mg, 96%). ^{1}H NMR (MeOD-d_4): δ 6.83 (m, 1H), 2.86 (t, 2H), 1.50 (m, 2H), 0.87 (t, 3H).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-propylaminosulfonyl)phenyl] urea

Following the general procedure for urea formation outlined in example 15, N-propyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (186mg, 0.71mmol) and 2-bromophenylisocyanate (140mg, 0.71mmol) were coupled to form the desired urea (149mg, 46%). LC-MS (m/z) 464.0 (M^+).

N-[4-chloro-2-hydroxy-3-(N"-propylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N-propyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (186mg, 071mmol) and 2,3-dichlorophenylisocyanate (133mg, 0.71mmol) were coupled to form the desired urea (259mg, 81%). LC-MS (m/z) 452.0 (M^+).

N-[4-chloro-2-hydroxyl-3-(N''-propylaminosulfonyl)phenyl]-N'-(2-chlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N-propyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (186mg, 0.71mmol) and 2-chlorophenylisocyanate (108mg, 0.71mmol) were coupled to form the desired urea (148mg, 50%). LC-MS (m/z) 418.2 (M^+).

Example 79, 80 and 81: Preparation of N-(2-bromophenyl)-N'-[4-chloro-3-(N''-ethylaminosulfonyl])-2-hydroxyphenyl] urea, N-[4-chloro-3-(N''-ethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea, and N-[4-chloro-3-(N''-ethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

N-ethyl-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (800mg, 2.75mmol), ethylamine (4.13mL, 8.26mmol) and triethylamine(1.15mL, 8.36mmol) were reacted to form the desired product (610mg, 74%). ^{1}H NMR (MeOD-d_4): δ 7.92 (d, 1H), 7.78 (d, 1H), 3.08 (q, 2H), 1.11 (t, 3H).

N-ethyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-ethyl-2,6-dichloro-3-nitrobenzenesulfonamide (1.16g, 3.88mmol), 60% NaH (466mg, 11.64mmol) and water (70μL, 3.88mmol) were reacted. The crude product (1.34g) was carried on to the next step without purification. ^{1}H NMR (MeOD-d_4): δ 8.07 (d, 1H), 7.25 (d, 1H), 3.05 (q, 2H), 1.12 (t, 3H).

N-ethyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, crude N-ethyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (1.34g) was reduced with hydrogen and 10% Pd/C (400mg) to form the desired product (800mg, 82% for two steps). ^{1}H NMR (MeOD-d_4): δ 6.85 (d, 1H), 6.78 (d, 1H), 2.85 (q, 2H), 0.95 (t, 3H).

N-(2-bromophenyl)-N'-[4-chloro-3-(N''-ethylaminosulfonyl])-2-hydroxyphenyl] urea

Following the general procedure for urea formation outlined in example 15, N-ethyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (266mg, 1.06mmol) and 2-bromophenylisocyanate (211mg, 1.06mmol) were coupled to form the desired urea (211mg, 44%). LC-MS (m/z) 450.0 (M^+).

N-[4-chloro-3-(N"-ethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea
Following the general procedure for urea formation outlined in example 15, N-ethyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (266mg, 1.06mmol) and 2-chlorophenylisocyanate (163mg, 1.06mmol) were coupled to form the desired urea (142mg, 33%). LC-MS (m/z) 04.0 (M^+).

N-[4-chloro-3-(N"-ethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea
Following the general procedure for urea formation outlined in example 15, N-ethyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (266mg, 1.06mmol) and 2,3-dichlorophenylisocyanate (200mg, 1.06mmol) were coupled to form the desired urea (193mg, 41%). LC-MS (m/z) 440.0 (M^+).

<u>Example 82 and 136:</u> Preparation of N-(2-bromophenyl)-N'-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea and N-[3-[N"-(5-amino-5-carboxypentyl)-aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea trifluoroacetate

N-[5-(tert-butoxycarbonylamino)-5-methoxycarbonylpentyl]-2,6-dichloro-3-nitrobenzenesulfonamide
Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (2.0g, 6.88mmol), Boc-Lys-OMe acetate (2.206g, 6.88mmol) and triethylamine(2.4mL, 17.2mmol) were reacted to form the desired product (1.25g, 35%). ^{1}H NMR (MeOD-d_4): δ 7.93 (d, 1H), 7.78 (d, 1H), 4.02 (m, 1H), 3.70 (s, 3H), 3.04 (t, 2H), 1.69 (m, 2H), 1.50 (m, 4H), 1.43 (s, 9H).

N-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide
Following the general hydrolysis procedure outlined in example 15, N-[5-(tert-butoxycarbonylamino)-5-methoxycarbonylpentyl]-2,6-dichloro-3-nitrobenzenesulfonamide (1.2g, 2.33mmol), 60% NaH (379mg, 9.32mmol) and water (84μL, 4.66mmol) were reacted to form the desired product (850mg, 76%). ^{1}H NMR (MeOD-d_4): δ 8.05 (d, 1H), 7.22 (d, 1H), 4.00 (m, 1H), 3.01 (t, 2H), 1.72 (m, 2H), 1.50-1.65 (m, 4H), 1.44 (s, 9H).

N-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide
Following the general hydrogenation procedure outlined in example 15, N-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (204mg, 0.42mmol) was reduced with hydrogen and 10% Pd/C (100mg) to form the desired

product (189mg, 100%). ^1H NMR (MeOD-d_4): δ 6.84 (m, 1H), 4.08 (m, 1H), 2.92 (t, 2H), 1.75 (m, 2H), 1.55 (m, 4H), 1.44 (s, 9H).

N-(2-bromophenyl)-N'-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea

Following the general procedure for urea formation outlined in example 15, N-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (189mg, 0.42mmol) and 2-bromophenylisocyanate (84mg, 0.42mmol) were coupled to form the desired urea (20mg, 7%). LC-MS (m/z) 651.2 (M^+).

N-[3-[N"-(5-amino-5-carboxypentyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]- N'-(2-bromophenyl) urea trifluoroacetate

Following the general procedure for Boc deprotection in example 36, N-(2-bromophenyl)-N'-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]-aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea (108mg, 0.17mmol) was stirred in 1mL of trifluoroacetic acid to form the desired product (75mg, 66%). LC-MS (m/z) 551.2 (M^+).

<u>Example 83 and 137:</u> **Preparation of N-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea and N-[3-[N"-(5-amino-5-carboxypentyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride**

N-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (233mg, 0.518mmol) and 2,3-dichlorophenylisocyanate (98mg, 0.518mmol) were coupled to form the desired urea (100mg, 30%). LC-MS (m/z) 641.2 (M^+).

N-[3-[N"-(5-amino-5-carboxypentyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate

Following the general procedure for Boc deprotection in example 36, N-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea (100mg, 0.16mmol) was stirred in 1mL of trifluoroacetic acid to form the desired product (78mg, 74%). LC-MS (m/z) 541.0 (M^+).

Example 84 and 85: **Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N''-(2-hydroxyethyl)aminosulfonyl] urea and N-(2-bromophenyl)-N'-[3-[N''-[[(2-bromophenylamino)carboxy]ethyl]-aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea**

2-benzyloxyethylamine

To a solution of ethanolamine (5g, 81.8mmol) in 100mL of dried THF was added 60% NaH (3.27g, 81.8mmol) at room temperature. The mixture was heated to reflux for 30min, then benzyl chloride (9.32g, 73.6 mmol) was added. The resulting mixture was refluxed for 3 hours. The mixture was concentrated, the residue was diluted with 1N aq. HCl, extracted with dichloromethane. The aqueous layer was adjusted to pH > 14 with 10% aq. NaOH, extracted with dichloromethane. The organic was dried over $MgSO_4$, concentrated to give desired product (10.11g, 82%). ^{1}H NMR ($CDCl_3$): δ 7.34 (m, 5H), 4.54 (s, 2H), 3.54 (t, 2H), 2.93 (t, 2H).

N-(2-benzyloxyethyl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (2.0g, 6.88mmol), 2-benzyloxyethyl amine(1.04g, 6.88mmol) and triethylamine(1.92mL, 13.76mmol) were reacted to form the desired product (2.31g, 83%). ^{1}H NMR (MeOD-d_4): δ 7.69 (d, 1H), 7.53 (d, 1H), 7.25 (m, 3H), 7.14 (d, 2H), 4.26 (s, 2H), 3.45 (t, 2H), 3.36 (t, 2H).

N-(2-benzyloxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-(2-benzyloxyethyl)-2,6-dichloro-3-nitrobenzenesulfonamide (2.31g, 5.71mmol), 60% NaH (683mg, 17.1mmol) and water (103μL, 5.72mmol) were reacted to form the desired product (1.70g, 77%). LC-MS (m/z) 387.5(M^+).

N-(2-hydroxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N-(2-benzyloxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (366mg, 0.95mmol) was reduced with hydrogen and 10% Pd/C (170mg). The crude product (265mg) was carried on to the next step without purification.

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N''-(2-hydroxyethyl)-aminosulfonyl] urea and N-(2-bromophenyl)-N'-[3-[N''-[[(2-bromophenylamino)carboxy]ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea

Following the general procedure for urea formation outlined in example 15, crude N-(2-hydroxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (265mg) and 2-

bromophenylisocyanate(187mg, 0.95mmol) were coupled to form the desired urea 84 (54mg, 12% for two steps). LC-MS (m/z) 466.0 (M^+); and urea 85 (10mg, 1.6% for two steps). LC-MS (m/z) 663.0 (M^+).

Example 86 and 149: Preparation of N-[3-[N"-(2-benzyloxyethyl)-aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea and N-[3-[N"-(2-hydroxyethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

N-(2-benzyloxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

A mixture of N-(2-benzyloxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (157 mg, 0.41mmol) in THF (15mL) and 5% aq. $NaHCO_3$ (10mL) was stirred at room temperature, sodium dithionite (1.5g) was added in 0.2g potion. The mixture was acidified with 1N aq. HCl, extracted with ethyl acetate. The organic layer was dried over $MgSO_4$ and concentrated to give the desired product (120mg, 82%). LC-MS (m/z) 357.0 (M^+).

N-[3-[N"-(2-benzyloxyethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N-(2-benzyloxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (119mg, 0.33mmol) and 2,3-dichlorophenylisocyanate (44mg, 0.23mmol) were coupled to form the desired urea (94mg, 75%). LC-MS (m/z) 546.0 (M^+).

N-[3-[N"-(2-hydroxyethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

To a solution of N-[3-[N"-(2-benzyloxyethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea (46mg, 0.08mmol) in 3mL of dichloromethane was added iodotrimethylsilane (38mg, 0.19mmol). The mixture was stirred for 16 hours at room temperature. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (60/40, v/v), gave the desired product (14mg, 37%). LC-MS (m/z) 455.8 (M^+).

Example 87, 88, and 89: Preparation of N-(2-bromophenyl)-N'-[4-chloro-3-(N"-cyclopropylmethylaminosulfonyl)-2-hydroxy phenyl]urea, N-[4-chloro- 3-(N"-cyclopropylmethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea, and N-[4-chloro-3-(N"-cyclopropylmethylaminosulfonyl)-2-hydroxy]phenyl]-N'-(2-chlorophenyl)urea

N-cyclopropylmethyl-2,6 dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.5g, 5.2mmol), aminomethyl cyclopropane hydrochloride (0.56g, 5.2mmol) and triethylamine (1.8mL, 12.9 mmol) were reacted to form the desired product (1.28g, 84%). LC-MS m/z 325 (M^+).

6-chloro-N-cyclopropylmethyl-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-cyclopropylmethyl-2,6 dichloro-3-nitrobenzenesulfonamide (0.85g, 2.6mmol), 80% NaH (0.23g, 9.8mmol) and water (56μL, 3.1mmol) were reacted to form the desired product (0.58g, 72%). LC-MS m/z 307 M^+).

3-amino-6-chloro-N-cyclopropylmethyl-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, 6-chloro-N-cyclopropylmethyl-2-hydroxy-3-nitrobenzenesulfonamide (0.1g, 3.2mmol) was reduced with hydrogen and 10 % Pd/C (0.1g) to form the desired product (0.08g, 89%). LC-MS m/z 277 (M^+).

N-(2-bromophenyl)-N'-[4-chloro-3-(N"-cyclopropylmethylaminosulfonyl)-2-hydroxy phenyl]urea

Following the general procedure for urea formation outlined in example 15, 3-amino-6-chloro-N-cyclopropylmethyl-2-hydroxybenzenesulfonamide (0.23g, 0.77mmol) and 2-bromophenylisocyanate(100μL, 0.81mmol) were coupled to form the desired urea (0.19g, 52%). LC-MS m/z 474(M^+).

N-[4-chloro-3-(N"-cyclopropylmethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2,3 dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, 3-amino-6-chloro-N-cyclopropylmethyl-2-hydroxybenzenesulfonamide (0.23g, 0.77mmol) and 2,3-dichlorophenylisocyanate (100μL, 0.76mmol) were coupled to form the desired urea (0.19g, 53%). LC-MS m/z 464 (M^+).

N-[4-chloro-3-(N"-cyclopropylmethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl)urea

Following the general procedure for urea formation outlined in example 15, 3-amino-6-chloro-N-cyclopropylmethyl-2-hydroxybenzenesulfonamide (0.23g, 0.77mmol) and 2-chlorophenylisocyanate(95μL, 0.79mmol) were coupled to form the desired urea (0.07g, 21%). LC-MS m/z 430 (M^+).

Example 90, 91, and 92: Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N''-methoxy-N''-methylaminosulfonyl)phenyl]urea, N-[4-chloro-2-hydroxy-3-(N''-methoxy-N''-methylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea, and N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N''-methoxy-N''-methylaminosulfonyl)phenyl]urea

(N-methoxy N-methyl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.5g, 5.2mmol), N,O-Dimethylhydroxylamine hydrochloride (0.52g, 5.3mmol) and triethylamine (2.0mL, 14.3mmol) were reacted to form the desired product (1.04g, 63%). LC-MS m/z 315 (M^+).

(N-methoxy-N-methyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, (N-methoxy, N-methyl)-2,6-dichloro-3-nitrobenzenesulfonamide (1.0g, 3.2mmol), 80% NaH (0.30g, 9.6mmol) and water (58µl, 3.2mmol) were reacted to form the desired product (0.66g, 69%). LC-MS m/z 297 (M^+).

(N-methoxy-N-methyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, (N''-methoxy-N''-methyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (0.66g, 2.2mmol) was reduced with hydrogen and 10 % Pd/C (0.66g) to form the desired product (0.50g, 85%). LC-MS m/z 266.8 (M^+).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N''-methoxy-N''-methylaminosulfonyl)phenyl]urea

Following the general procedure for urea formation outlined in example 15, (N''-methoxy-N''-methyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.15g, 0.56mmol) and 2-bromophenylisocyanate (69µL, 0.56mmol) were coupled to form the desired urea (0.12g, 45%). LC-MS m/z 464(M^+).

N-[4-chloro-2-hydroxy-3-(N''-methoxy-N''-methylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea

Following the general procedure for urea formation outlined in example 15, (N''-methoxy-N''-methyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.15g, 0.56mmol) and 2,3-

dichlorophenylisocyanate (74µL, 0.56mmol) were coupled to form the desired urea (0.086g, 34%). LC-MS m/z 454(M^+).

N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-methoxy-N"-methylaminosulfonyl)phenyl]urea

Following the general procedure for urea formation outlined in example 15, (N"-methoxy-N"-methyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.15g, 0.56mmol) and 2-chlorophenylisocyanate (68µL, 0.56mmol) were coupled to form the desired urea (0.077g, 33%). LC-MS m/z 420(M^+).

<u>Example 93, 94, and 95</u>: **Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-pyrrolidinylaminosulfonyl)phenyl]urea, N-[4-chloro-2-hydroxy-3-(N"-pyrrolidinylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea, and N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-pyrrolidinylaminosulfonyl)phenyl]urea**

(N-pyrrolidinyl)-2,6 dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.51g, 5.2mmol), pyrrolidine (435µL, 5.2mmol) and triethylamine(1.1mL, 7.8mmol) were reacted to form the desired product (1.16g, 68%). LC-MS m/z 325(M^+).

(N-pyrrolidinyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, (N-pyrrolidinyl)-2,6 dichloro-3-nitrobenzenesulfonamide (1.12g, 3.4mmol), 80% NaH (0.31g, 10.3mmol) and water (74µL, 4.1mmol) were reacted to form the desired product (0.94g, 69%). LC-MS m/z 307(M^+).

(N-pyrrolidinyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, (N-pyrrolidinyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (0.73g, 2.4mmol) was reduced with hydrogen and 10 % Pd/C (0.73g) to form the desired product (0.69g, crude). MS m/z (M+H) 276.9, 278.89, 279.88.

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-pyrrolidinyl aminosulfonyl)phenyl]urea

Following the general procedure for urea formation outlined in example 15, (N-pyrrolidinyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

(0.23g, 0.83mmol) and 2-bromophenylisocyanate (102µL, 0.83mmol) were coupled to form the desired urea (0.1g, 26%). LC-MS m/z 476(M^+).

N-[4-chloro-2-hydroxy-3-(N"-pyrrolidinylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea

Following the general procedure for urea formation outlined in example 15, (N-pyrrolidinyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.23g, 0.83mmol) and 2,3-dichlorophenylisocyanate(110µL, 0.83mmol) were coupled to form the desired urea (0.10g, 26%). LC-MS m/z 464(M^+).

N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-pyrrolidinylaminosulfonyl)phenyl]urea

Following the general procedure for urea formation outlined in example 15, (N-pyrrolidinyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.23g, 0.83mmol) and 2-chlorophenylisocyanate(100µL, 0.83mmol) were coupled to form the desired urea (0.1g, 28%). LC-MS m/z 420(M^+).

<u>Example 96 and 97</u>: **Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(4-pyridinylaminosulfonyl]phenyl] urea and N-[4-chloro-2-hydroxy-3-[(4-pyridinylaminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea.**

N-(4-Pyridinyl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (500mg, 1.72mmol), 4-aminopyridine (165mg,1.75mmol) and triethylamine (0.36mL,2.58mmol) were reacted to form the desired product (446mg, 76%). EI-MS m/z 346$(M-H)^-$.

N-(4-Pyridinyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-(4-pyridinyl)-2,6-dichloro-3-nitrobenzenesulfonamide (540mg, 1.55mmol), 80% NaH (217mg,7.25mmol) and water (0.045mL, 2.46mmol) were reacted to form the desired product (170mg, 33%). EI-MS m/z 328$(M-H)^-$.

N-(4-Pyridinyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N-(4-pyridinyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (22.0mg, 0.066mmol) was reduced with hydrogen and Pd/C (10.3mg) to form the desired product (18.0mg, 90%). EI-MS m/z 298$(M-H)^-$.

N-(2-Bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(4-pyridinylaminosulfonyl]phenyl] urea
Following the general procedure for urea formation outlined in example 15 , N-(4-pyridinyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (52.6mg, 0.17mmol) and 2-bromophenylisocyanate (0.0216mL, 0.17mmol) were coupled to form the desired urea (66.5mg, 76%). EI-MS m/z 496(M-H)$^-$.

N-[4-Chloro-2-hydroxy-3-[(4-pyridinylaminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea.
Following the general procedure for urea formation outlined in example 15 , N-(4-pyridinyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (52.6mg, 0.017mmol) and 2,3-dichlorophenylisocyanate (0.023mL, 0.17mmol) were coupled to form the desired urea (62.8mg, 73%). EI-MS m/z 485(M-H)$^-$.

<u>Example 98 and 99</u>: **N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[[[2-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] urea and N-[4-chloro-2-hydroxy-3-[[[2-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea.**
N-(2-Tetrahydrofurfuryl)-2,6-dichloro-3-nitrobenzenesulfonamide
Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (997mg, 3.43mmol), 2-tetrahydrofurfurylamine (0.37mL, 3.58mmol) and triethylamine (0.72mL, 5.16mmol) were reacted to form the desired product (1.04g, 86%). EI-MS m/z 353(M-H)$^-$.

N-(2-Tetrahydrofurfuryl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide
Following the general hydrolysis procedure outlined in example 15, N-(2-tetrahydrofurfuryl)-2,6-dichloro-3-nitrobenzenesulfonamide (660mg, 1.86mmol), 80% NaH (169mg, 5.63mmol) and water (0.035mL, 1.95mmol) were reacted to form the desired product (380mg, 61%). EI-MS m/z 335(M-H)$^-$.

N-(2-Tetrahydrofurfuryl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide
Following the general hydrogenation procedure outlined in example 15, N-(2-tetrahydrofurfuryl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (340mg, 1.01mmol) was reduced with hydrogen and Pd/C (158mg) to form the desired product (304mg, 98%). EI-MS m/z 305(M-H)$^-$.

N-(2-Bromophenyl)-N'-[4-chloro-2-hydroxy-3-[[[2-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] urea

Following the general procedure for urea formation outlined in example 15 , N-(2-tetrahydrofurfuryl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (152mg, 0.49mmol) and 2-bromophenylisocyanate (0.061mL, 0.49mmol) were coupled to form the desired urea (98mg, 40%). EI-MS m/z 504(M-H)$^-$

N-[4-Chloro-2-hydroxy-3-[[[2-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15 , N-(2-tetrahydrofurfuryl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (152mg, 0.49mmol) and 2,3-dichlorophenylisocyanate (0.065mL, 0.49mmol) were coupled to form the desired urea (184mg, 76%). EI-MS m/z 492(M-H)$^-$.

<u>Example 100 and 101</u>: Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[[[(2R)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] urea and N-[4-chloro-2-hydroxy-3-[[[(2R)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea.

N-((2R)-Tetrahydrofurfuryl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (993mg, 3.41mmol), (2R)-tetrahydrofurfurylamine (0.36mL, 3.49mmol) and triethylamine(0.72mL, 5.17mmol) were reacted to form the desired product (1.17g, 97%). EI-MS m/z 353(M-H)$^-$.

N-((2R)-Tetrahydrofurfuryl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-((2R)-tetrahydrofurfuryl)-2,6-dichloro-3-nitrobenzenesulfonamide (1.17g, 3.29mmol), 80% NaH (303mg, 10.1mmol) and water (0.063mL, 3.49mmol) were reacted to form the desired product (690mg, 63%). EI-MS m/z 335(M-H)$^-$.

N-((2R)-Tetrahydrofurfuryl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N-((2R)-tetrahydrofurfuryl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (660mg, 1.96mmol) was reduced with hydrogen and Pd/C (303mg) to form the desired product (563mg, 94%). EI-MS m/z 305(M-H)$^-$.

N-(2-Bromophenyl)-N'-[4-chloro-2-hydroxy-3-[[[(2R)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] urea

Following the general procedure for urea formation outlined in example 15 , N-((2R)-tetrahydrofurfuryl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (260mg, 0.85mmol) and 2-bromophenylisocyanate (0.11mL, 0.85mmol) were coupled to form the desired urea (127mg, 30%). EI-MS m/z 504(M-H)$^-$

N-{4-Chloro-2-hydroxy-3-[[[(2R)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15 , N-((2R)-tetrahydrofurfuryl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (260mg, 0.85mmol) and 2,3-dichlorophenylisocyanate (0.11mL, 0.85mmol) were coupled to form the desired urea (306mg, 75%). EI-MS m/z 492(M-H)$^-$.

<u>Example 102 and 103</u>: Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[[[(2S)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] urea and N-[4-chloro-2-hydroxy-3-[[[(2S)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea.

N-((2S)-Tetrahydrofurfuryl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.00g, 3.44mmol), (2S)-tetrahydrofurfurylamine (0.33mL, 3.20mmol) and triethylamine (0.72mL, 5.17mmol) were reacted to form the desired product (1.12g, 99%). EI-MS m/z 353(M-H)$^-$.

N-((2S)-Tetrahydrofurfuryl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-((2S)-tetrahydrofurfuryl)-2,6-dichloro-3-nitrobenzenesulfonamide (1.12g, 3.15mmol), 80% NaH (284mg, 9.47mmol) and water (0.057mL, 3.16mmol) were reacted to form the desired product (280mg, 26%). EI-MS m/z 335(M-H)$^-$.

N-((2S)-Tetrahydrofurfuryl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N-((2S)-tetrahydrofurfuryl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (270mg, 0.80mmol) was reduced with hydrogen and Pd/C (140mg) to form the desired product (226mg, 94%). EI-MS m/z 305(M-H)$^-$.

N-(2-Bromophenyl)-N'-[4-chloro-2-hydroxy-3-[[[(2S)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] urea

Following the general procedure for urea formation outlined in example 15 , N-((2S)-tetrahydrofurfuryl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (113mg, 0.37mmol) and 2-bromophenylisocyanate (0.045mL, 0.37mmol) were coupled to form the desired urea (143mg, 77%). EI-MS m/z 504(M-H)$^-$

N-[4-Chloro-2-hydroxy-3-[[[(2S)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15 , N-((2S)-tetrahydrofurfuryl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (113mg, 0.37mmol) and 2,3-dichlorophenylisocyanate (0.049mL, 0.37mmol) were coupled to form the desired urea (52.5mg, 29%). EI-MS m/z 492(M-H)$^-$.

<u>Example 104, 105, and 106</u>: **Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N''-cyclopentylaminosulfonyl)phenyl]urea, N-[4-chloro-2-hydroxy-3-(N''-cyclopentylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea, and N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N''-cyclopentylaminosulfonyl)phenyl]urea**

(N-cyclopentyl)-2,6 dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.6g, 5.5mmol), cyclopentylamine (0.54mL, 5.5mmol) and triethylamine (1.1mlL, 7.8mmol) were reacted to form the desired product (1.1g, 59%). LC-MS m/z 339(M$^+$).

(N-cyclopentyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, (N-cyclopentyl)-2,6 dichloro-(3-nitrobenzenesulfonamide (0.76g, 2.2mmol), 80% NaH (0.22g, 7.3mmol) and water (45μL, 2.5mmol) were reacted to form the desired product (0.49g, 68%). LC-MS m/z 321(M$^+$).

(N-cyclopentyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, (N-cyclopentyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (0.54g, 1.7mmol) was reduced with hydrogen and 10 % Pd/C (0.54g) to form the desired product (0.45g, crude). LC-MS m/z 291(M$^+$).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N''-cyclopentylaminosulfonyl)phenyl]urea

Following the general procedure for urea formation outlined in example 15, (N-cyclopentyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.15g, 0.52mmol) and 2-

bromophenylisocyanate (64µL, 0.52mmol) were coupled to form the desired urea (0.1g, 39%). LC-MS m/z 488(M^+).

N-[4-chloro-2-hydroxy-3-(N"-cyclopentylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea

Following the general procedure for urea formation outlined in example 15, (N-cyclopentyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.15g, 0.52mmol) and 2,3-dichlorophenylisocyanate(68µL, 0.52mmol) were coupled to form the desired urea (0.10g, 40%). LC-MS m/z 478(M^+).

N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-cyclopentylaminosulfonyl)phenyl]urea

Following the general procedure for urea formation outlined in example 15, (N-cyclopentyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.15g, 0.52mmol) and 2-chlorophenylisocyanate (62µL, 0.52mmol) were coupled to form the desired urea (0.1g, 43%). LC-MS m/z 444(M^+).

__Example 107, 108, and 109__: **Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl)phenyl]urea, N-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea, and N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl)phenyl]urea**

N-(ethoxycarbonyl)isoxazolidine

To a solution of KOH (6.4g, 0.11mol) and hydroxyurethane (12g, 0.11mol) in ethanol (50mL) was added 1,3-dibromopropane (5.8mL, 0.057mol). The resulting suspension was heated at reflux for 1 hour. After the mixture was cooled to room temperature, an additional portion of KOH (3.2g, 0.055mol) and of dibromopropane (2.9mL, 0.028mol) was added. The mixture was then refluxed for 1 hour, cooled to room temperature, and solvent was evaporated. The residue was suspended in boiling ether three times and filtered. The combined filtrates were dried over sodium sulfate, filtered, and evaporated. A portion of 3g of the crude product was purified by flush column chromatography (EtOAC/Hexane, gradient elution), yielding 1.18g of N-(ethoxycarbonyl)isoxazolidine. ^{1}H NMR (CDCl3) δ 1.15(t, 3H), 2.15 (q, 2H), 3.55(t, 2H), 3.8 (t, 2H),4.1(q, 2H).

Isoxazolidine hydrochloride

N-(ethoxycarbonyl)isoxazolidine (1.18g, 9.1mmol) was dissolved in aqueous HCl (6N, 7mL)and heated at reflux for 2 hours. After being cooled to room temperature, this solution

was washed with ether (3x) and then evaporated affording crude isoxazolidine hydrochloride which was recrystalized from ethanol/ether yielding 0.79 g (80%) of isoxazolidine hydrochloride.[1] H NMR ($CDCl_3$; CH_3OD), δ 2.5 (q, 2H), 3.55 (t, 2H), 4.2(t, 2H).

(N-isoxazolidinyl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.5g, 5.2mmol), isoxazolidine hydrochloride (0.56g, 5.2mmol) and triethylamine (2.2mL, 15.5 mmol) were reacted to form the desired product (1.2g, 71%). LC-MS m/z 327 (M^+).

(N-isoxazolidinyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, (N-isoxazolidinyl)-2,6-dichloro-3-nitrobenzenesulfonamide (1.08g, 3.3mmol), 80% NaH (0.3g, 10.0mmol) and water (72µL, 4mmol) were reacted to form the desired product (0.79g, 77%). LC-MS m/z 309(M^+).

(N-isoxazolidinyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, (N-isoxazolidinyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (0.84g, 2.7mmol) was reduced with hydrogen and 10 % Pd/C (0.84g) to form the desired product (0.75g crude). LC-MS m/z 279(M^+).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl)phenyl]urea

Following the general procedure for urea formation outlined in example 15, (N-isoxazolidinyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.25g, 0.90mmol) and 2-bromophenylisocyanate (110µL, 0.90mmol) were coupled to form the desired urea (0.1g, 23%). LC-MS m/z 476(M^+).

N-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea

Following the general procedure for urea formation outlined in example 15, (N-isoxazolidinyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.25g, 0.90mmol) and 2,3-dichlorophenylisocyanate (120µL, 0.91mmol) were coupled to form the desired urea (0.10g, 24%). LC-MS m/z 466(M^+).

N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl)phenyl]urea

Following the general procedure for urea formation outlined in example 15, (N-isoxazolidinyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.25g, 0.90mmol) and 2-chlorophenylisocyanate (110μL, 0.91mmol) were coupled to form the desired urea (0.1g, 23%). LC-MS m/z 432(M^+).

<u>Example 110, 111, and 112</u>: Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-tetrahydroisoxazylaminosulfonyl)phenyl]urea, N-[4-chloro-2-hydroxy-3-(N"-tetrahydroisoxazylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea, and N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-tetrahydroisoxazylaminosulfonyl)phenyl]urea

N-(ethoxycarbonyl)tetrahydroisoxazine

To a solution of KOH (3.34g, 59.6mmol) and hydroxyurethane (6.1g, 58.5mmol) in ethanol (25mL) was added 1,4–dibromobutane (3.5mL, 29.3mmol). The resulting suspension was heated at reflux for 1 hour. After the mixture was cooled to room temperature, an additional portion of KOH (1.65g, 29.4mmol) and of dibromopropane (1.8mL, 15mmol) was added. The mixture was then refluxed for 1 hour, cooled to room temperature, and solvent was evaporated. The residue was suspended in boiling ether three times and filtered. The combined filtrates were dried over sodium fulfate, filtered, and evaporated. A portion of 4g of the crude product was purified by flush column chromatography (EtOAC/Hexane, gradient elution), yielding 1.85g of N-(ethoxycarbonyl)tetrahydroisoxazine. ^{1}H NMR ($CDCl_3$) δ 1.05 (q, 3H), 1.45 (dd, 2H), 1.55 (dd, 2H), 3.4 (t, 2H), 3.7 (t, 2H), 3.95 (q, 2H).

Tetrahydroisoxazine hydrochloride

N-(ethoxycarbonyl)tetrahydroisoxazine (1.85g, 11.6mmol) was dissolved in aqueous HCl (6N, 7.8mL)and heated at reflux for 7 hours. After being cooled to room temperature, this solution was washed with ether (3x) and then evaporated affording crude tetraisoxazine hydrochloride which was recrystalized from ethanol/ether yielding 0.74 g (52%) of tetrahydroisoxazine hydrochloride.^{1}H NMR (CH_3OD) δ 1.85 (dd, 2H), 1.95 (dd, 2H), 3.4 (t, 2H), 4.25 (t, 2H).

(N-tetrahydroisoxazyl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride(1.75g, 6.0mmol), tetrahydroisoxazine

hydrochloride (0.63g, 5.1mmol) and triethylamine (2.2mL, 15.5 mmol) were reacted to form the desired product (1.32g, 75%). LC-MS m/z 341(M^+).

(N-tetrahydroisoxazyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, (N-tetrahydroisoxazyl)-2,6 dichloro-3-nitrobenzenesulfonamide (0.1g, 0.29mmol), 80% NaH (26mg, 0.88mmol) and water (6.3μL, 0.35mmol) were reacted to form the desired product (50mg, 53%). LC-MS m/z 323(M^+).

(N-tetrahydroisoxazyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, (N-tetrahydroisoxazyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (0.76g, 2.35mmol) was reduced with hydrogen and 10 % Pd/C (0.76) to form the desired product (0.89g, crude). LC-MS m/z 293(M^+).

Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-tetrahydroisoxazylaminosulfonyl)phenyl]urea

Following the general procedure for urea formation outlined in example 15, (N-tetrahydroisoxazyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.3g, 1.0mmol) and 2-bromophenylisocyanate (126μL, 1.0mmol) were coupled to form the desired urea (0.1g, 20%). LC-MS m/z 490(M^+).

N-[4-chloro-2-hydroxy-3-(N"-tetrahydroisoxazylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea

Following the general procedure for urea formation outlined in example 15, (N-tetrahydroisoxazyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.3g, 1.0mmol) and 2,3-dichlorophenylisocyanate (135μL, 1.0mmol) were coupled to form the desired urea (0.10g, 20%). LC-MS m/z 480(M^+).

N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-tetrahydroisoxazylaminosulfonyl)phenyl]urea

Following the general procedure for urea formation outlined in example 15, (N-tetrahydroisoxazyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (0.3g, 1.0mmol) and 2-chlorophenylisocyanate (124μL, 1.0mmol) were coupled to form the desired urea (0.1g, 22%). LC-MS m/z 446(M^+).

<u>Example 113, 114 and 115</u>: Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl)aminosulfonyl]phenyl] urea, N-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl) aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea and N-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl)-aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea

N-(2-isopropoxyethyl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.50g, 5.16mmol), 2-aminoethyl isopropyl ether (0.533g, 5.16mmol) and triethylamine (1.42mL, 10.32mmol) were reacted to form the desired product (1.63g, 89%). LC-MS (m/z) 357.0 (M^+).

N-(2-isopropoxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-(2-isopropoxyethyl)-2,6-dichloro-3-nitrobenzenesulfonamide (1.635g, 4.58mmol), 60% NaH (0.41g, 13.74mmol) and water (0.099mL, 5.50mmol) were reacted. The crude product (1.676g) was carried on to the next step without purification. LC-MS (m/z) 340 $(M-H)^+$.

N-(2-isopropoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, crude N-(2-isopropoxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (1.17g) was reduced with hydrogen and Pd/C (350mg). The crude product (1.086g) was carried on to the next step without purification. ^{1}H NMR (MeOD-d_4): δ 6.92 (d, 1H), 6.85 (d, 1H), 3.45 (m, 1H), 3.39 (t, 2H), 3.10 (t, 2H), 1.05 (d, 6H).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl)-aminosulfonyl]phenyl] urea

Following the general procedure for urea formation outlined in example 15, crude N-(2-isopropoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (362mg) and 2-bromophenylisocyanate (0.132mL, 1.07mmol) were coupled to form the desired urea (155mg, 29% for 3 steps). LC-MS (m/z) 508 $(M-H)^+$.

N-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl) aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, crude N-(2-isopropoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (362mg) and 2,3-

dichlorophenylisocyanate (0.141mL, 1.07mmol) were coupled to form the desired urea (264mg, 50% for 3 steps). LC-MS (m/z) 498 $(M-H)^+$.

N-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl)aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea
Following the general procedure for urea formation outlined in example 15, crude N-(2-isopropoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (362mg) and 2-chlorophenylisocyanate (0.129mL, 1.07mmol) were coupled to form the desired urea (170mg, 34% for 3 steps). LC-MS (m/z) 462 $(M-H)^+$.

<u>Example 116, 117 and 118:</u> **Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(2-ethoxyethyl)aminosulfonyl]phenyl] urea, N-[4-chloro-2-hydroxy-3-[(2-ethoxyethyl) aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea and N-[4-chloro-2-hydroxy-3-[(2-ethoxyethyl)-aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea**

N-(2-ethoxyethyl)-2,6-dichloro-3-nitrobenzenesulfonamide
Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (1.50g, 5.16mmol), 2-aminoethyl ethyl ether (0.46g, 5.16mmol) and triethylamine (1.42mL, 10.32mmol) were reacted to form the desired product (1.78g, 100%). LC-MS (m/z) 345.0 (M^+).

N-(2-ethoxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide
Following the general hydrolysis procedure outlined in example 15, N-(2-ethoxyethyl)-2,6-dichloro-3-nitrobenzenesulfonamide (1.78g, 5.16mmol), 80% NaH (0.46g, 15.48mmol) and water (111μL, 6.20mmol) were reacted. The crude product (1.63g) was carried onto the next step without purification. LC-MS (m/z) 325.0(M^+).

N-(2-ethoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide
Following the general hydrogenation procedure outlined in example 15, crude N-(2-ethoxyethyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (0.98g) was reduced with hydrogen and Pd/C (250mg). The crude product (1.01g) was carried onto the next step without purification. ^{1}H NMR (MeOD-d_4): δ 6.88 (m, 2H), 3.40 (t, 2H), 3.36 (m, 2H), 3.13 (t, 2H), 1.08 (t, 3H).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(2-ethoxyethyl)aminosulfonyl]phenyl] urea
Following the general procedure for urea formation outlined in example 15, crude N-(2-ethoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (333mg) and 2-

bromophenylisocyanate (204mg, 1.03mmol) were coupled to form the desired urea (130mg, 26% for 3 steps). LC-MS (m/z) 494.0 $(M\text{-}H)^+$.

N-[4-chloro-2-hydroxy-3-[(2-ethoxyethyl) aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea.

Following the general procedure for urea formation outlined in example 15, crude N-(2-ethoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (333mg) and 2,3-dichlorophenylisocyanate (194mg, 1.03mmol) were coupled to form the desired urea (185mg, 37% for 3 steps). LC-MS (m/z) 484.0 $(M\text{-}H)^+$.

N-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl)aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, crude N-(2-ethoxyethyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (333mg) and 2-chlorophenylisocyanate (158mg, 1.03mmol) were coupled to form the desired urea (138mg, 30% for 3 steps). LC-MS (m/z) 448.2$(M\text{-}H)^+$.

<u>Example 119, 120 and 121</u>: Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(2-methoxycarbonyl)azetidin-1-yl]sulfonylphenyl] urea, N-[4-chloro-2-hydroxy-3-[(2-methoxycarbonyl)azetidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea and N-[4-chloro-2-hydroxy-3-[(2-carboxy)-azetidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea

2-acetoxy-L-azetidine

A solution of L-azetidine-carboxylic acid (700mg, 6.92mmol) and 1mL of chlorotrimethylsilane in 10mL of methanol was heated to reflux overnight. The mixture was concentrated to give the desired product quantitatively (796mg), no purification. ^1H NMR ($CDCl_3$): δ 9.49 (s, 1H), 5.20(m, 2H), 4.27 (m, 1H), 4.14 (m, 1H), 3.82 (s, 3H), 2.81 (m, 1H), 2.71 (m, 1H).

2,6-dichloro-1-[(2-methoxycarbonyl)azetidin-1-yl]sulfonyl-3-nitrobenzene

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (2.01g, 6.92mmol), 2-acetoxy-L-azetidine (796mg, 6.92 mmol) and triethylamine(1.75mL, 17.3mmol) were reacted to form the desired product (1.84g, 72%). ^1H NMR ($CDCl_3$): δ 7.68 (d, 1H), 7.61 (d, 1H), 5.09 (t, 1H), 4.46 (m, 1H), 4.06 (m, 1H), 3.59 (s, 3H), 2.55 (m, 1H), 2.49 (m, 1H).

6-chloro-2-hydroxy-1-[(2-methoxycarbonyl)azetidin-1-yl]sulfonyl-3-nitrobenzene

To a solution of 2,6-dichloro-1-[(2-methoxycarbonyl)azetidin-1-yl]sulfonyl-3-nitrobenzene (1.94g, mmol) at room temperature was added potassium superoxide (946mg, 13.3mmol) in 50mg potion. The mixture was stirred for 20 hours. The mixture was acidified with 1N aq. HCl, extracted with ethyl acetate. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane/acetic acid (40/58/2, v/v/v) gave the desired product (767mg, 42%). LC-MS (m/z) 351.0 (M^+).

6-chloro-2-hydroxy-1-[(2-methoxycarbonyl)azetidin-1-yl]sulfonylaniline
Following the general hydrogenation procedure outlined in example 15, 6-chloro-2-hydroxy-1-[(2-methoxycarbonyl)azetidin-1-yl]sulfonyl-3-nitrobenzene (742mg, 2.12mmol) was reduced with hydrogen and 10% Pd/C (250mg) to form the desired product (649mg, 96%). ^{1}H NMR (MeOD-d_4): δ 6.86 (m, 2H), 4.95 (t, 1H), 4.17 (m, 1H), 3.94 (m, 1H), 3.56 (s, 3H), 2.45 (m, 2H).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(2-methoxycarbonyl)azetidin-1-yl]sulfonylphenyl] urea
Following the general procedure for urea formation outlined in example 15, 6-chloro-2-hydroxy-1-[(2-methoxycarbonyl)azetidin-1-yl]sulfonylaniline (325mg, 1.01mmol) and 2-bromophenylisocyanate (201mg, 1.01mmol) were coupled to form the desired urea (390mg, 74%). LC-MS (m/z) 520.0 (M^+).

N-[4-chloro-2-hydroxy-3-[(2-methoxycarbonyl)azetidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea
Following the general procedure for urea formation outlined in example 15, 6-chloro-2-hydroxy-1-[(2-methoxycarbonyl)azetidin-1-yl]sulfonylaniline (325mg, 1.01mmol) and 2,3-dichlorophenylisocyanate (190mg, 1.01mmol) were coupled to form the desired urea (479mg, 93%). LC-MS (m/z) 510.0 (M^+).

N-[4-chloro-2-hydroxy-3-[(2-carboxy)-azetidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea
A solution of N-[4-chloro-2-hydroxy-3-[(2-methoxycarbonyl)azetidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea (359mg, 0.71mmol) and lithium hydroxide monohydrate (296mg) in methanol (10mL) and water (1mL) was stirred at room temperature for 16 hours. The mixture was concentrated, the residue was acidified with 1N aq. HCl. The resulting mixture was filtered, the white solid was collected and dried *in vacuo* to give the desired product (332mg, 95%). LC-MS (m/z) 496.0 (M^+).

<u>Example 122, 123 and 124</u>: Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[3-(4-morpholinyl)propyl]aminosulfonyl]phenyl] urea hydrochloride, N-[4-chloro-2-hydroxy-3-[N"-[3-(4-morpholinyl)propyl]-aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride and N-[4-chloro-2-hydroxy-3-[N"-[3-(4-morpholinyl)propyl]aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea hydrochloride

N-[3-(4-morpholinyl)propyl]-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (2.0g, 6.88mmol), 4-(3-aminopropyl)morpholine (993mg, 6.88mmol) and triethylamine(1.92mL, 13.76mmol) were reacted to form the desired product (2.04g, 74%). LC-MS (m/z) 398.0 (M^+).

N-[3-(4-morpholinyl)propyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-[3-(4-morpholinyl)propyl]-2,6-dichloro-3-nitrobenzenesulfonamide (1.0g, 2.51mmol), 60% NaH (301mg, 7.53mmol) and water (54μL, 3.0mmol) were reacted. The mixture was acidified with 4.0N HCl in 1,4-dioxane and concentrated to give the crude product (1.01g), which was carried onto the next steps without purification. LC-MS 380.0 (M^+).

N-[3-(4-morpholinyl)propyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, crude N-[3-(4-morpholinyl)propyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (1.01g) was reduced with hydrogen and 10% Pd/C (250mg). The crude product (890mg) was carried onto the next step without purification. ^{1}H NMR (MeOD-d_4): δ 6.86 (m, 2H), 3.87 (m, 4H), 3.15 (m, 6H), 2.98 (t, 2H), 1.92 (m, 2H).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[3-(4-morpholinyl)propyl]-aminosulfonyl]phenyl] urea hydrochloride

Following the general procedure for urea formation outlined in example 15, crude N-[3-(4-morpholinyl)propyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (297mg) and 2-bromophenylisocyanate (166mg, 0.83mmol) were coupled to form the desired urea (191mg, 39% for 3 steps). LC-MS (m/z) 549.2 (M^+).

N-[4-chloro-2-hydroxy-3-[N"-[3-(4-morpholinyl)propyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride

Following the general procedure for urea formation outlined in example 15, crude N-[3-(4-morpholinyl)propyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (297mg) and 2,3-

dichlorophenylisocyanate (157mg, 0.83mmol) were coupled to form the desired urea (134mg, 28% for 3 steps). LC-MS (m/z) 539.2 (M^+).

N-[4-chloro-2-hydroxy-3-[N"-[3-(4-morpholinyl)propyl]aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea hydrochloride

Following the general procedure for urea formation outlined in example 15, crude N-[3-(4-morpholinyl)propyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (297mg) and 2-chlorophenylisocyanate (127mg, 0.83mmol) were coupled to form the desired urea (133mg, 29% for 3 steps). LC-MS (m/z) 503.2 (M^+).

<u>Example 125 and 126</u>: **Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylphenyl] urea and N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(-)-(2-hydroxymethyl)pyrrolidin-1-yl]sulfonylphenyl] urea**

2,6-dichloro-1-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonyl-3-nitrobenzene

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (2.0g, 6.88mmol), S-(-)-2-(methoxymethyl)pyrrolidine (793mg, 6.88mmol) and triethylamine(1.9mL, 13.76mmol) were reacted to form the desired product (2.2mg, 87%). LC-MS (m/z) 369.0 (M^+).

6-chloro-2-hydroxy-1-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonyl-3-nitrobenzene

Following the general hydrolysis procedure outlined in example 15, 2,6-dichloro-1-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonyl-3-nitrobenzene (1.0g, 2.71mmol), 60% NaH (325mg, 8.13mmol) and water (59μL, 3.3mmol) were reacted. The crude product (1.0g) was carried onto the next step without purification. LC-MS (m/z) 351.0 (M^+).

4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylaniline

Following the general hydrogenation procedure outlined in example 15, crude 6-chloro-2-hydroxy-1-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonyl-3-nitrobenzene (1.0g) was reduced with hydrogen and 10% Pd/C (320mg). The crude product (0.92g) was carried onto the next step without purification. ^{1}H NMR (MeOD-d_4): δ 6.91 (d, 1H), 6.89 (d, 1H), 4.41 (m, 1H), 3.39 (m, 2H), 3.21 (s, 3H), 1.83-1.97 (m, 6H).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylphenyl] urea

Following the general procedure for urea formation outlined in example 15, crude 4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylaniline (306mg) and 2-bromophenylisocyanate (188mg, 0.95mmol) were coupled to form the desired urea (170.4mg, 35% for 3 steps). LC-MS (m/z) 520.0(M^+)

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(-)-(2-hydroxymethyl)pyrrolidin-1-yl]sulfonylphenyl] urea

To a solution of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylphenyl] urea (92mg, 0.18mmol) in dichloromethane at ice-bath was added 1.0M boron tribromide (0.53mL, 0.53mmol) in dichloromethane. The mixture was stirred for 16 hours. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane (50/50, v/v) gave the desired product (65mg, 73%). LC-MS (m/z) 506.0 (M^+).

<u>Example 127 and 128</u>: N-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea and N-[4-chloro-2-hydroxy-3-[S-(-)-(2-hydroxymethyl)-pyrrolidin-1-ylsulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea

N-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonyl-phenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, crude 4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylaniline (306mg) and 2,3-dichlorophenylisocyanate (179mg, 0.95mmol) were coupled to form the desired urea (218mg, 45% for 3 steps). LC-MS (m/z) 510.2 (M^+).

N-[4-chloro-2-hydroxy-3-[S-(-)-(2-hydroxymethyl)-pyrrolidin-1-yl]sulfonyl]phenyl-N'-(2,3-dichlorophenyl) urea

Following the deprotection procedure outlined in example 126, N-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonyl-phenyl]-N'-(2,3-dichlorophenyl) urea (80mg, 0.16mmol) and 1.0M boron tribromide (0.78mL, 0.78mmol) were reacted to the desired product (50mg, 64%). LC-MS (m/z) 494.0 (M^+).

<u>Example 129 and 130</u>:N-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)-pyrrolidin-1-yl]sulfonylphenyl]-N'-(2-chlorophenyl) urea and N-[4-chloro-2-hydroxy-3-[S-(-)-(2-hydroxymethyl)-pyrrolidin-1-yl]sulfonylphenyl]-N'-(2-chlorophenyl) urea

N-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylphenyl]-N'-(2-chlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, crude 4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylaniline (306mg) and 2-chlorophenylisocyanate (146mg, 0.96mmol) were coupled to form the desired urea (129mg, 29% for 3 steps). LC-MS (m/z) 474.2 (M^+).

N-[4-chloro-2-hydroxy-3-[S-(-)-(2-hydroxymethyl)-pyrrolidin-1-yl]sulfonylphenyl]-N'-(2-chlorophenyl) urea

Following the deprotection procedure outlined in example 126, N-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylphenyl]-N'-(2-chlorophenyl) urea (63mg, 0.13mmol) and 1.0M boron tribromide (0.65mL, 0.65mmol) were reacted to give the desired product (35mg, 58%). LC-MS (m/z) 460.0 (M^+).

<u>Example 131 and 132</u>: **Preparation of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(2-methoxycarbonyl)pyrrolidin-1-yl]sulfonylphenyl] urea and N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(2-carboxy)pyrrolidin-1-yl]sulfonylphenyl] urea**

2,6-dichloro-1-[S-(2-methoxycarbonyl)pyrrolidin-1-yl]sulfonyl-3-nitrobenzene

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (4.79g, 16.5mmol), L-proline methyl ester hydrochloride (2.73g, 16.5mmol) and triethylamine(4.60mL, 33mmol) were reacted to form the desired product (5.02g, 79%). LC-MS (m/z) 383.0 (M^+).

6-chloro-2-hydroxy-1-[S-(2-methoxycarbonyl)pyrrolidin-1-yl]sulfonyl-3-nitrobenzene

To a solution 2,6-dichloro-1-[S-(2-methoxycarbonyl)pyrrolidin-1-yl]sulfonyl-3-nitrobenzene (1.0g, 2.6mmol) at room temperature was added potassium superoxide (370mg, 5.2 mmol) in 50mg potion. The mixture was stirred for 16 hours. The mixture was acidified with 1N aq. HCl, extracted with ethyl acetate. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane/acetic acid (50/48/2, v/v/v) gave the desired product (384mg, 40%). LC-MS (m/z) 365.2 (M^-).

4-chloro-2-hydroxy-3-[S-(2-methoxycarbonyl)pyrrolidin-1-yl]sulfonylaniline

Following the general hydrogenation procedure outlined in example 15, 6-chloro-2-hydroxy-1-[S-(2-methoxycarbonyl)pyrrolidin-1-yl]sulfonyl-3-nitrobenzene (380mg, 1.04mmol) was reduced with hydrogen and 10% Pd/C (110mg) to form the desired product (340mg, 98%). ^1H NMR (MeOD-d_4): δ 6.84 (m, 2H), 4.58 (m, 1H), 3.67 (s, 3H), 2.25 (m, 2H), 2.10 (m, 2H), 1.95 (m, 2H).

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(2-methoxycarbonyl)pyrrolidin-1-yl]sulfonylphenyl] urea

Following the general procedure for urea formation outlined in example 15, 4-chloro-2-hydroxy-3-[S-(2-methoxycarbonyl)pyrrolidin-1-yl]sulfonylaniline (339mg, 1.01mmol) and 2-bromophenylisocyanate (201mg, 1.01mmol) were coupled to form the desired urea (223mg, 41%). LC-MS (m/z) 534.0 (M^+)

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(2-carboxy)pyrrolidin-1-yl]sulfonylphenyl] urea

A solution of N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(2-methoxycarbonyl)pyrrolidin-1-yl]sulfonylphenyl] urea (40mg, 0.075mmol) and lithium hydroxide monohydrate (40mg) in methanol (10mL) and water (1mL) was stirred at room temperature for 16 hours. The mixture was concentrated, the residue was acidified with 1N aq. HCl. The resulting mixture was filtered, the white solid was collected and dried *in vacuo* to give the desired product (39mg, 100%). LC-MS (m/z) 520.0 (M^+)

__Example 133, 134 and 135__: **Preparation of N-(2-bromophenyl)-N'-[3-[N"-(tert-butyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea, N-[3-[N"-(tert-butyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea and N-[3-[N"-(tert-butyl)aminosulfonyl]-4-chloro-2-hydroxylphenyl]-N'-(2-chlorophenyl) urea**

N-(tert-butyl)-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (2.0g, 6.88mmol), tert-butylamine (503mg, 6.88mmol) and triethylamine(1.43mL, 10.32mmol) were reacted to form the desired product (1.67g, 75%). ^{1}H NMR (MeOD-d_4): δ 7.91 (d, 1H), 7.78 (d, 1H), 1.25 (s, 9H).

N-(tert-butyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N-(tert-butyl)-2,6-dichloro-3-nitrobenzenesulfonamide (1.67g, 5.1mmol), 60% NaH (612mg, 15.3mmol) and water (92μL, 5.1mmol) were reacted to form the crude product (1.54g), which was carried on to the next step without purification. ^{1}H NMR (MeOD-d_4): δ 8.00 (d, 1H), 7.08 (d, 1H), 1.24 (s, 9H).

N-(tert-butyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, crude N-(tert-butyl)-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (1.54g) was reduced with hydrogen

and 10% Pd/C (670mg). The crude product (1.23g) was carried on to the next step without purification. ^1H NMR (MeOD-d_4): δ 6.82 (m, 2H), 1.22 (s, 9H).

N-(2-bromophenyl)-N'-[3-[N"-(tert-butyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea

Following the general procedure for urea formation outlined in example 15, crude N-(tert-butyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (410mg) and 2-bromophenylisocyanate (322mg, 1.62mmol) were coupled to form the desired urea (228mg, 32% for 3 steps). LC-MS (m/z) 478.0 (M^+)

N-[3-[N"-(tert-butyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, crude N-(tert-butyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (410mg) and 2,3-dichlorophenylisocyanate (304mg, 1.62mmol) were coupled to form the desired urea (336.1mg, 49% for 3 steps). LC-MS (m/z) 468.0 (M^+)

N-[3-[N"-(tert-butyl)aminosulfonyl]-4-chloro-2-hydroxylphenyl]-N'-(2-chlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, crude N-(tert-butyl)-3-amino-6-chloro-2-hydroxybenzenesulfonamide (410mg) and 2-chlorophenylisocyanate (249mg, 1.62mmol) were coupled to form the desired urea (243mg, 38% for 3 steps). LC-MS (m/z) 432.0 (M^+)

<u>Example 138 and 139</u>: Preparation of N-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea and N-[3-[N"-(5-amino-5-carboxypentyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea hydrochloride

N-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (233mg, 0.52mmol) and 2-chlorophenylisocyanate (80mg, 0.52mmol) were coupled to form the desired urea (97mg, 31%). LC-MS (m/z) 605.2 (M^+).

N-[3-[N"-(5-amino-5-carboxypentyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea hydrochloride

Following the general procedure for Boc deprotection in example 36, N-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-

chlorophenyl) urea (104mg, 0.17mmol) was stirred in 1mL of trifluoroacetic acid to form the desired product (64mg, 61%). LC-MS (m/z) 505.0 (M^+).

<u>Example 142, 143 and 144</u>: Preparation of N-[4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea, N-(2-bromophenyl)-N'-[4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyphenyl] urea and N-[4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea

6-chloro-1-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxy-3-nitrobenzene

A solution of 6-chloro-2-hydroxy-3-nitro-1-(4-thiomorpholinylsufonyl)benzene (563mg, 1.67mmol) and m-chloroperbenzoic acid (1.73g, 5.01mmol) in dichloromethane (60mL) was stirred for 3 days at room temperature. The mixture was diluted with ethyl acetate and washed with water to give the crude. Purification by column chromatography on silica gel, eluting with ethyl acetate/hexane/acetic acid (49/50/1, v/v/v), gave the desired product (230mg, 37%). EI-MS (m/z) 368.92, 371.03 (M^+).

4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyaniline

Following the general hydrogenation procedure outlined in example 15, 6-chloro-1-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxy-3-nitrobenzene (220mg, 0.60mmol) was reduced with hydrogen and 10% Pd/C (100mg) to give the desired (186mg, 92%). ^{1}H NMR (MeOD-d_4): δ 6.88 (m, 2H), 3.85 (t, 4H), 3.22 (t, 4H).

N-[4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, 4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyaniline (62mg, 0.18mmol) and 2,3-dichlorophenylisocyanate (41mg, 0.22mmol) were coupled to form the desired urea (32mg, 34%). LC-MS (m/z) 528.0 (M^+).

N-(2-bromophenyl)-N'-[4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyphenyl] urea

Following the general procedure for urea formation outlined in example 15, 4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyaniline (62mg, 0.18mmol) and 2-bromophenylisocyanate (44mg, 0.22mmol) were coupled to form the desired urea (28mg, 29%). LC-MS (m/z) 539.8 (M^+).

N-[4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, 4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyaniline (62mg, 0.018mmol) and 2-chlorophenylisocyanate (34mg, 0.22mmol) were coupled to form the desired urea (29mg, 32%). LC-MS (m/z) 496.0 (M^+).

<u>Example 145 and 146</u>: Preparation of N-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea and N-[3-[N"-(2-aminoethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate

N-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N-[2-(tert-butoxycarbonylamino)ethyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (220 mg, 0.60 mmol) and 2,3-dichlorophenylisocyanate (125 mg, 0.66 mmol) were coupled to form the desired urea (220mg, 66%). LC-MS (m/z) 553.2 (M^+).

N-[3-[N"-(2-aminoethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate

Following the general procedure for Boc deprotection outlined in example 36, N-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea (56 mg, 0.10 mmol) was stirred in trifluoroacetic acid to form the desired product (57 mg, 100 %). LC-MS (m/z) 453.0 (M^+).

<u>Example 147 and 148</u>: Preparation of N-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea and N-[3-[N"-(2-aminoethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea trifluoroacetate

N-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N-[2-(tert-butoxycarbonylamino)ethyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide (220mg, 0.60mmol) and 2-bromophenylisocyanate(101mg, 0.66mmol) were coupled to form the desired urea (169mg, 54%). LC-MS (m/z) 519.2 (M^+).

N-[3-[N"-(2-aminoethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea trifluoroacetate

Following the general procedure for Boc deprotection outlined in example 36, N-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea (57mg, 0.11mmol) was stirred in trifluoroacetic acid to form the desired product (51mg, 87%). LC-MS (m/z) 419.2 (M^+).

<u>Example 150</u>: Preparation of N-[4-chloro-2-hydroxy-3- (N",N"-dimethylaminosulfonyl)phenyl]-N'-(2-chlorophenyl) urea.

a) N-dimethyl-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (2.0 g, 6.9 mmol), dimethylamine (2.0 M in MeOH, 3.5 mL, 6.9 mmol) and triethylamine (1.44 mL, 10.35 mmol) were reacted to form the desired product (1.45 g, 70.4 %). EI-MS m/z 298 $(M-H)^-$.

b) N",N"-dimethyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, N",N"-dimethyl-2,6-dichloro-3-nitrobenzenesulfonamide (2.64 g, 8.83 mmol), NaH (60 %, 1.06 g, 26.5 mmol) and water (191 mg, 10.6 mmol) were reacted to form the desired product (2.3 g, 93 %). EI-MS m/z 279.5 $(M-H)^-$.

c) N",N"-dimethyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, N",N"-dimethyl-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (2.3 g, 8.2 mmol) was reduced with hydrogen and Pd/C (2.3 g) to form the desired product (2.0 g, 97 %). EI-MS m/z 249.5 $(M-H)^-$.

d) N-[4-chloro-2-hydroxy-3-[(N",N"-dimethylaminosulfonyl)phenyl]-N'-(2-chlorophenyl) urea

Following the general procedure for urea formation outlined in example 15, N",N"-dimethyl-3-amino-6-chloro-2-hydroxybenzenesulfonamide (200 mg, 0.8 mmol) and 2-chlorophenylisocyanate (123 mg, 0.8 mmol) were coupled to form the desired urea (270 mg, 83 %). EI-MS m/z 403.2 $(M-H)^-$.

<u>Example 151:</u> Preparation of N-[4-chloro-2-hydroxy-3-(aminosulfonyl)phenyl]-N'-(2-chloro-3-fluorophenyl) urea

a) 2-chloro-3-fluoronitrobenzene

To a –78°C solution of 3-fluoronitrobenzene (2 g, 14.2 mmol) in THF (30 mL) was added N-chlorosuccinimide (5.69 g, 42.6 mmol) in THF (20 mL), NaHMDS (1 M in THF, 28.4 mL, 28.4 mmol) was then added dropwise to maintain an internal temperature below –75°C. The resulting mixture was stirred for 30 min at –78°C. Then it was partitioned between 5% of HCl and ethyl acetate. The combined organic layer is dried over $MgSO_4$ and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (20% Ethyl acetate/ Hexane) gave the desired product(231 mg, 9.2 %). EI-MS m/z 176.5 (M^+).

b) 2-chloro-3-fluoroaniline

To the solution of 2-chloro-3-fluoronitrobenzene (231 mg, 1.32 mmol) in ethanol (10 ml), Tin (II) chloride (1.48 g, 6.6 mmol) was added. The reaction mixture was stirred at room temperature for 16 hours. The $NaHCO_3$ (aq) was added to pH= 7. Then was extracted with ethyl acetate (3x). The combined organic layer was dried over $MgSO_4$, filtered and concentrated under reduced pressure to give desired product (136 mg, 71%). EI-MS m/z 146.5 (M^+).

c) N-[4-chloro-2-hydroxy-3-(aminosulfonyl)phenyl]-N'-(2-chloro-3-fluorophenyl) urea

To a solution of 2-chloro-3-fluoroaniline (136 mg, 0.94 mmol) in toluene (10 mL), triphosgene (111 mg, 0.37 mmol) and triethyl amine (0.13 mL, 1.12 mmol) were added. The reaction mixture was stirred at 80°C for 4 hours. Then the reaction mixture was concentrated under reduced pressure and then it was added to 3-amino-6-chloro-2-hydroxybenzenesulfonamide (104 mg, 0.47 mmol) in DMF (1 mL). The reaction mixture was stirred at room temperature for 16 hours. Chromatography of the resulting liquid on silica gel (30%Ethyl acetate/Hexane) gave desired product (80 mg, 43%). EI-MS m/z 395.2 (M^+).

<u>Example 152</u>:Preparation of N-[4-chloro-2-hydroxy-3-(aminosulfonyl)phenyl]-N'-(2-bromo-3-fluorophenyl) urea

a) 2-chloro-3-fluoronitrobenzene

To a –78°C solution of 3-fluoronitrobenzene (2 g, 14.2 mmol) in THF (30 mL) was added N-bromosuccinimide (7.58 g, 42.6 mmol) in THF (20 mL), NaHMDS (1 M in THF, 28.4 mL, 28.4 mmol) was then added dropwise to maintain an internal temperature below –75°C. The resulting mixture was stirred for 30 min at –78°C. Then it was partitioned between 5% of HCL and ethyl acetate. . The combined organic layer is dried over $MgSO_4$ and filtered. The solvent was evaporated and chromatography of the resulting solid on silica gel (20% Ethyl acetate/ Hexane) gave the desired product (300 mg, 9.6 %). EI-MS m/z 221 (M^+).

b) 2-chloro-3-fluoroaniline

To the solution of 2-bromo-3-fluoronitrobenzene (100 mg, 0.46 mmol) in ethanol (5 ml), Tin (II) chloride (520 mg, 2.3 mmol) was added. The reaction mixture was stirred at room temperature for 16 hours. The $NaHCO_3$ (aq) was added to pH= 7. Then was extracted with ethyl acetate (3x). The combined organic layer was dried over $MgSO_4$, filtered and concentrated under reduced pressure to give desired product (80 mg, 93%). EI-MS m/z 191 (M^+).

c) N-[4-chloro-2-hydroxy-3-(aminosulfonyl)phenyl]-N'-(2-bromo-3-fluorophenyl) urea

To a solution of 2-bromo-3-fluoroaniline (42 mg, 0.0.22 mmol) in toluene (5 mL), triphosgene (26 mg, 0.09 mmol) and triethyl amine (0.04 mL, 0.26 mmol) were added. The reaction mixture was stirred at 80°C for 4 hours. Then the reaction mixture was concentrated under reduced pressure and then it was added to 3-amino-6-chloro-2-hydroxybenzenesulfonamide (44 mg, 0.22 mmol) in DMF (1 mL), The reaction mixture was stirred at room temperature for 16 hours. Chromatography of the resulting liquid on silica gel (30%Ethyl acetate/Hexane) gave desired product (7 mg, 7 %). EI-MS m/z 439.6 (M^+).

<u>Example 153, 154 and 155</u>: **Preparation of N-(2-bromophenyl)-N'-[4-chloro-3-[(1-ethyl-pyrrolidin-2-yl)methylaminosulfonyl]-2-hydroxyphenyl] urea hydrochloride, N-[4-chloro-3-[(1-ethyl-pyrrolidin-2-yl)methylaminosulfonyl]-2-hydroxyphenyl] N'-(2,3-dichlorophenyl) urea hydrochloride and N-[4-chloro-3-[(1-ethyl-pyrrolidin-2-yl)methylaminosulfonyl]-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea hydrochloride**

N-[(1-ethyl-pyrrolidin-2-yl)methyl]-2,6-dichloro-3-nitrobenzenesulfonamide

Following the general procedure for sulfonamide formation outlined in example 15, 2,6-dichloro-3-nitrobenzenesulfonyl chloride (2.0g, 6.88mmol), 2-aminomethyl-1-ethyl-prrolidine (882mg, 6.88mmol) and triethylamine(1.92mL, 13.76mmol) were reacted . The crude product (2.64g) was carried on to the next step without purification. LC-MS (m/z) 382.0 (M^+).

N-[(1-ethyl-pyrrolidin-2-yl)methyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide

Following the general hydrolysis procedure outlined in example 15, crude N-[(1-ethyl-pyrrolidin-2-yl)methyl]-2,6-dichloro-3-nitrobenzenesulfonamide (1.50g), 60% NaH (471mg, 11.78mmol) and water (85µL, 4.72mmol) were reacted to form the crude product (1.98g), which was carried on to the next step without purification. LC-MS (m/z) 364.2 (M^+).

N-[(1-ethyl-pyrrolidin-2-yl)methyl]-3-amino-6-chloro-2-hydroxybenzenesulfonamide

Following the general hydrogenation procedure outlined in example 15, crude N-[(1-ethyl-pyrrolidin-2-yl)methyl]-6-chloro-2-hydroxy-3-nitrobenzenesulfonamide (2.18g) was reduced with hydrogen and 10% Pd/C (300mg). The crude product (1.85g) was carried on to the next step without purification.

N-(2-bromophenyl)-N'-[4-chloro-3-[(1-ethyl-pyrrolidin-2-yl)methylaminosulfonyl]-2-hydroxyphenyl] urea hydrochloride

Following the general procedure for urea formation outlined in example 15, crude N-[(1-ethyl-pyrrolidin-2-yl)methyl]-3-amino-6-chloro-2-hydroxybenzene-sulfonamide (616mg) and 2-bromophenylisocyanate (176mg, 0.89mmol) were coupled to form the desired urea (14mg, 3% for 4 steps). LC-MS (m/z) 533.0 (M^+)

N-[4-chloro-3-[(1-ethyl-pyrrolidin-2-yl)methylaminosulfonyl]-2-hydroxyphenyl] N'-(2,3-dichlorophenyl) urea hydrochloride

Following the general procedure for urea formation outlined in example 15, crude N-[(1-ethyl-pyrrolidin-2-yl)methyl]-3-amino-6-chloro-2-hydroxybenzene-sulfonamide (616mg) and 2,3-dichlorophenylisocyanate (167mg, 89mmol) were coupled to form the desired urea (13mg, 2.3% for 4 steps). LC-MS (m/z) 523.2 (M^+)

N-[4-chloro-3-[(1-ethyl-pyrrolidin-2-yl)methylaminosulfonyl]-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea hydrochloride

Following the general procedure for urea formation outlined in example 15, crude N-[(1-ethyl-pyrrolidin-2-yl)methyl]-3-amino-6-chloro-2-hydroxybenzene-sulfonamide (410mg) and 2-chlorophenylisocyanate (249mg, 1.62mmol) were coupled to form the desired urea (50mg, 9.6% for 4 steps). LC-MS (m/z) 487.2 (M^+)

METHOD OF TREATMENT

The compounds of Formula (I), or a pharmaceutically acceptable salt thereof can be used in the manufacture of a medicine for the prophylactic or therapeutic treatment of any disease state in a human, or other mammal, which is exacerbated or caused by excessive or

unregulated IL-8 cytokine production by such mammal's cell, such as but not limited to monocytes and/or macrophages, or other chemokines which bind to the IL-8 α or β receptor, also referred to as the type I or type II receptor.

Accordingly, the present invention provides a method of treating a chemokine mediated disease, wherein the chemokine is one which binds to an IL-8 α or β receptor and which method comprises administering an effective amount of a compound of Formula (I) or a pharmaceutically acceptable salt thereof. In particular, the chemokines are IL-8, GROα, GROβ, GROγ, NAP-2 or ENA-78.

The compounds of Formula (I) are administered in an amount sufficient to inhibit cytokine function, in particular IL-8, GROα, GROβ, GROγ, NAP-2 or ENA-78, such that they are biologically regulated down to normal levels of physiological function, or in some case to subnormal levels, so as to ameliorate the disease state. Abnormal levels of IL-8, GROα, GROβ, GROγ, NAP-2 or ENA-78 for instance in the context of the present invention, constitute: (i) levels of free IL-8 greater than or equal to 1 picogram per mL; (ii) any cell associated IL-8, GROα, GROβ, GROγ, NAP-2 or ENA-78 above normal physiological levels; or (iii) the presence of IL-8, GROα, GROβ, GROγ, NAP-2 or ENA-78 above basal levels in cells or tissues in which IL-8, GROα, GROβ, GROγ, NAP-2 or ENA-78 respectively, is produced.

The compounds of Formula (I), in generally have been shown to have a longer $t_{1/2}$ and improved oral bioavailabilty over the compounds disclosed in WO 96/25157 and WO 97/29743 whose disclosures are incorporated herein by reference.

There are many disease states in which excessive or unregulated IL-8 production is implicated in exacerbating and/or causing the disease. Chemokine mediated diseases include psoriasis, atopic dermatitis, osteo arthritis, rheumatoid arthritis, asthma, chronic obstructive pulmonary disease, adult respiratory distress syndrome, inflammatory bowel disease, Crohn's disease, ulcerative colitis, stroke, septic shock, multiple sclerosis, endotoxic shock, gram negative sepsis, toxic shock syndrome, cardiac and renal reperfusion injury, glomerulonephritis, thrombosis, graft vs. host reaction, alzheimers disease, allograft rejections, malaria, restinosis, angiogenesis, atherosclerosis, osteoporosis, gingivitis and undesired hematopoietic stem cells release and diseases caused by respiratory viruses, herpesviruses, and hepatitis viruses, meningitis, herpes encephalitis, CNS vasculitis, traumatic brain injury, CNS tumors, subarachnoid hemorrhage, post surgical trauma, interstitial pneumonitis, hypersensitivity, crystal induced arthritis, acute and chronic pancreatitis, acute alcoholic hepatitis, necrotizing enterocolitis, chronic sinusitis, uveitis, polymyositis, vasculitis, acne, gastric and duodenal ulcers, celiac disease, esophagitis, glossitis, airflow obstruction, airway hyperresponsiveness, bronchiolitis obliterans organizing pneumonia, bronchiectasis, bronchiolitis, bronchiolitis obliterans, chronic

bronchitis, cor pulmonae, dyspnea, emphysema, hypercapnea, hyperinflation, hypoxemia, hypoxia, surgerical lung volume reduction, pulmonary fibrosis, pulmonary hypertension, right ventricular hypertropy, sarcoidosis, small airway disease, ventilation-perfusion mismatching, wheeze and lupus.

These diseases are primarily characterized by massive neutrophil infiltration, T-cell infiltration, or neovascular growth, and are associated with increased IL-8, GROα, GROβ, GROγ, NAP-2 or ENA-78 production which is responsible for the chemotaxis of neutrophils into the inflammatory site or the directional growth of endothelial cells. In contrast to other inflammatory cytokines (IL-1, TNF, and IL-6), IL-8, GROα, GROβ, GROγ, NAP-2 or ENA-78 have the unique property of promoting neutrophil chemotaxis, enzyme release including but not limited to elastase release as well as superoxide production and activation. The α-chemokines but particularly, GROα, GROβ, GROγ, NAP-2 or ENA-78, working through the IL-8 type I or II receptor can promote the neovascularization of tumors by promoting the directional growth of endothelial cells. Therefore, the inhibition of IL-8 induced chemotaxis or activation would lead to a direct reduction in the neutrophil infiltration.

Recent evidence also implicates the role of chemokines in the treatment of HIV infections, Littleman *et al.*, Nature 381, pp. 661 (1996) and Koup *et al.*, Nature 381, pp. 667 (1996).

Present evidence also indicates the use of IL-8 inhibitors in the treatment of atherosclerosis. The first reference, Boisvert et al., J. Clin. Invest, 1998, 101:353-363 shows, through bone marrow transplantation, that the absence of IL-8 receptors on stem cells (and, therefore, on monocytes/macrophages) leads to a reduction in the development of atherosclerotic plaques in LDL receptor deficient mice. Additional supporting references are: Apostolopoulos, et al., Arterioscler. Thromb. Vasc. Biol. 1996, 16:1007-1012; Liu, et al., Arterioscler. Thromb. Vasc. Biol, 1997, 17:317-323; Rus, et al., Atherosclerosis. 1996, 127:263-271.; Wang et al., J. Biol. Chem. 1996, 271:8837-8842; Yue, et al., Eur. J. Pharmacol. 1993, 240:81-84; Koch, et al., Am. J. Pathol., 1993, 142:1423-1431.; Lee, et al., Immunol. Lett., 1996, 53, 109-113.; and Terkeltaub et al., Arterioscler. Thromb., 1994, 14:47-53.

The present invention also provides for a means of treating, in an acute setting, as well as preventing, in those individuals deemed susceptible to, CNS injuries by the chemokine receptor antagonist compounds of Formula (I).

CNS injuries as defined herein include both open or penetrating head trauma, such as by surgery, or a closed head trauma injury, such as by an injury to the head region. Also included within this definition is ischemic stroke, particularly to the brain area.

Ischemic stroke may be defined as a focal neurologic disorder that results from insufficient blood supply to a particular brain area, usually as a consequence of an embolus, thrombi, or local atheromatous closure of the blood vessel. The role of inflammatory cytokines in this area has been emerging and the present invention provides a mean for the potential treatment of these injuries. Relatively little treatment, for an acute injury such as these has been available.

TNF-α is a cytokine with proinflammatory actions, including endothelial leukocyte adhesion molecule expression. Leukocytes infiltrate into ischemic brain lesions and hence compounds which inhibit or decrease levels of TNF would be useful for treatment of ischemic brain injury. See Liu *et al.*, Stroke, Vol. 25., No. 7, pp. 1481-88 (1994) whose disclosure is incorporated herein by reference.

Models of closed head injuries and treatment with mixed 5-LO/CO agents is discussed in Shohami *et al.*, J. of Vaisc & Clinical Physiology and Pharmacology, Vol. 3, No. 2, pp. 99-107 (1992) whose disclosure is incorporated herein by reference. Treatment, which reduced edema formation, was found to improve functional outcome in those animals treated.

The compounds of Formula (I) are administered in an amount sufficient to inhibit IL-8, binding to the IL-8 alpha or beta receptors, from binding to these receptors, such as evidenced by a reduction in neutrophil chemotaxis and activation. The discovery that the compounds of Formula (I) are inhibitors of IL-8 binding is based upon the effects of the compounds of Formulas (I) in the *in vitro* receptor binding assays which are described herein. The compounds of Formula (I) have been shown to be inhibitors of type II IL-8 receptors.

As used herein, the term "IL-8 mediated disease or disease state" refers to any and all disease states in which IL-8, GROα, GROβ, GROγ, NAP-2 or ENA-78 plays a role, either by production of IL-8, GROα, GROβ, GROγ, NAP-2 or ENA-78 themselves, or by IL-8, GROα, GROβ, GROγ, NAP-2 or ENA-78 causing another monokine to be released, such as but not limited to IL-1, IL-6 or TNF. A disease state in which, for instance, IL-1 is a major component, and whose production or action, is exacerbated or secreted in response to IL-8, would therefore be considered a disease state mediated by IL-8.

As used herein, the term "chemokine mediated disease or disease state" refers to any and all disease states in which a chemokine which binds to an IL-8 α or β receptor plays a role, such as but not limited to IL-8, GRO-α, GRO-β, GROγ, NAP-2 or ENA-78. This would include a disease state in which, IL-8 plays a role, either by production of IL-8 itself, or by IL-8 causing another monokine to be released, such as but not limited to IL-1, IL-6 or TNF. A disease state in which, for instance, IL-1 is a major component, and whose

production or action, is exacerbated or secreted in response to IL-8, would therefore be considered a disease stated mediated by IL-8.

As used herein, the term "cytokine" refers to any secreted polypeptide that affects the functions of cells and is a molecule, which modulates interactions between cells in the immune, inflammatory or hematopoietic response. A cytokine includes, but is not limited to, monokines and lymphokines, regardless of which cells produce them. For instance, a monokine is generally referred to as being produced and secreted by a mononuclear cell, such as a macrophage and/or monocyte. Many other cells however also produce monokines, such as natural killer cells, fibroblasts, basophils, neutrophils, endothelial cells, brain astrocytes, bone marrow stromal cells, epideral keratinocytes and B-lymphocytes. Lymphokines are generally referred to as being produced by lymphocyte cells. Examples of cytokines include, but are not limited to, Interleukin-1 (IL-1), Interleukin-6 (IL-6), Interleukin-8 (IL-8), Tumor Necrosis Factor-alpha (TNF-α) and Tumor Necrosis Factor beta (TNF-β).

As used herein, the term "chemokine" refers to any secreted polypeptide that affects the functions of cells and is a molecule which modulates interactions between cells in the immune, inflammatory or hematopoietic response, similar to the term "cytokine" above. A chemokine is primarily secreted through cell transmembranes and causes chemotaxis and activation of specific white blood cells and leukocytes, neutrophils, monocytes, macrophages, T-cells, B-cells, endothelial cells and smooth muscle cells. Examples of chemokines include, but are not limited to IL-8, GRO-α, GRO-β, GRO-γ, NAP-2, ENA-78, IP-10, MIP-1α, MIP-β, PF4, and MCP 1, 2, and 3.

In order to use a compound of Formula (I) or a pharmaceutically acceptable salt thereof in therapy, it will normally be formulated into a pharmaceutical composition in accordance with standard pharmaceutical practice. This invention, therefore, also relates to a pharmaceutical composition comprising an effective, non-toxic amount of a compound of Formula (I) and a pharmaceutically acceptable carrier or diluent.

Compounds of Formula (I), pharmaceutically acceptable salts thereof and pharmaceutical compositions incorporating such may conveniently be administered by any of the routes conventionally used for drug administration, for instance, orally, topically, parenterally or by inhalation. The compounds of Formula (I) may be administered in conventional dosage forms prepared by combining a compound of Formula (I) with standard pharmaceutical carriers according to conventional procedures. The compounds of Formula (I) may also be administered in conventional dosages in combination with a known, second therapeutically active compound. These procedures may involve mixing, granulating and compressing or dissolving the ingredients as appropriate to the desired preparation. It will be appreciated that the form and character of the pharmaceutically

acceptable character or diluent is dictated by the amount of active ingredient with which it is to be combined, the route of administration and other well-known variables. The carrier(s) must be "acceptable" in the sense of being compatible with the other ingredients of the formulation and not deleterious to the recipient thereof.

The pharmaceutical carrier employed may be, for example, either a solid or liquid. Exemplary of solid carriers are lactose, terra alba, sucrose, talc, gelatin, agar, pectin, acacia, magnesium stearate, stearic acid and the like. Exemplary of liquid carriers are syrup, peanut oil, olive oil, water and the like. Similarly, the carrier or diluent may include time delay material well known to the art, such as glyceryl mono-stearate or glyceryl distearate alone or with a wax.

A wide variety of pharmaceutical forms can be employed. Thus, if a solid carrier is used, the preparation can be tableted, placed in a hard gelatin capsule in powder or pellet form or in the form of a troche or lozenge. The amount of solid carrier will vary widely but preferably will be from about 25mg to about 1g. When a liquid carrier is used, the preparation will be in the form of a syrup, emulsion, soft gelatin capsule, sterile injectable liquid such as an ampule or nonaqueous liquid suspension.

Compounds of Formula (I) may be administered topically, that is by non-systemic administration. This includes the application of a compound of Formula (I) externally to the epidermis or the buccal cavity and the instillation of such a compound into the ear, eye and nose, such that the compound does not significantly enter the blood stream. In contrast, systemic administration refers to oral, intravenous, intraperitoneal and intramuscular administration.

Formulations suitable for topical administration include liquid or semi-liquid preparations suitable for penetration through the skin to the site of inflammation such as liniments, lotions, creams, ointments or pastes, and drops suitable for administration to the eye, ear or nose. The active ingredient may comprise, for topical administration, from 0.001% to 10% w/w, for instance from 1% to 2% by weight of the Formulation. It may however comprise as much as 10% w/w but preferably will comprise less than 5% w/w, more preferably from 0.1% to 1% w/w of the Formulation.

Lotions according to the present invention include those suitable for application to the skin or eye. An eye lotion may comprise a sterile aqueous solution optionally containing a bactericide and may be prepared by methods similar to those for the preparation of drops. Lotions or liniments for application to the skin may also include an agent to hasten drying and to cool the skin, such as an alcohol or acetone, and/or a moisturizer such as glycerol or an oil such as castor oil or arachis oil.

Creams, ointments or pastes according to the present invention are semi-solid formulations of the active ingredient for external application. They may be made by

mixing the active ingredient in finely-divided or powdered form, alone or in solution or suspension in an aqueous or non-aqueous fluid, with the aid of suitable machinery, with a greasy or non-greasy base. The base may comprise hydrocarbons such as hard, soft or liquid paraffin, glycerol, beeswax, a metallic soap; a mucilage; an oil of natural origin such as almond, corn, arachis, castor or olive oil; wool fat or its derivatives or a fatty acid such as steric or oleic acid together with an alcohol such as propylene glycol or a macrogel. The formulation may incorporate any suitable surface active agent such as an anionic, cationic or non-ionic surfactant such as a sorbitan ester or a polyoxyethylene derivative thereof. Suspending agents such as natural gums, cellulose derivatives or inorganic materials such as silicaceous silicas, and other ingredients such as lanolin, may also be included.

Drops according to the present invention may comprise sterile aqueous or oily solutions or suspensions and may be prepared by dissolving the active ingredient in a suitable aqueous solution of a bactericidal and/or fungicidal agent and/or any other suitable preservative, and preferably including a surface active agent. The resulting solution may then be clarified by filtration, transferred to a suitable container which is then sealed and sterilized by autoclaving or maintaining at 98-100^{o}C for half an hour. Alternatively, the solution may be sterilized by filtration and transferred to the container by an aseptic technique. Examples of bactericidal and fungicidal agents suitable for inclusion in the drops are phenylmercuric nitrate or acetate (0.002%), benzalkonium chloride (0.01%) and chlorhexidine acetate (0.01%). Suitable solvents for the preparation of an oily solution include glycerol, diluted alcohol and propylene glycol.

Compounds of formula (I) may be administered parenterally, that is by intravenous, intramuscular, subcutaneous intranasal, intrarectal, intravaginal or intraperitoneal administration. The subcutaneous and intramuscular forms of parenteral administration are generally preferred. Appropriate dosage forms for such administration may be prepared by conventional techniques. Compounds of Formula (I) may also be administered by inhalation that is by intranasal and oral inhalation administration. Appropriate dosage forms for such administration, such as an aerosol formulation or a metered dose inhaler, may be prepared by conventional techniques.

For all methods of use disclosed herein for the compounds of Formula (I) the daily oral dosage regimen will preferably be from about 0.01 to about 80 mg/kg of total body weight. The daily parenteral dosage regimen about 0.001 to about 80 mg/kg of total body weight. The daily topical dosage regimen will preferably be from 0.1 mg to 150 mg, administered one to four, preferably two or three times daily. The daily inhalation dosage regimen will preferably be from about 0.01 mg/kg to about 1 mg/kg per day. It will also be recognized by one of skill in the art that the optimal quantity and spacing of individual dosages of a compound of Formula (I) or a pharmaceutically acceptable salt thereof will be

determined by the nature and extent of the condition being treated, the form, route and site of administration, and the particular patient being treated, and that such optimums can be determined by conventional techniques. It will also be appreciated by one of skill in the art that the optimal course of treatment, i.e., the number of doses of a compound of Formula (I) or a pharmaceutically acceptable salt thereof given per day for a defined number of days, can be ascertained by those skilled in the art using conventional course of treatment determination tests.

The invention will now be described by reference to the following biological examples which are merely illustrative and are not to be construed as a limitation of the scope of the present invention.

BIOLOGICAL EXAMPLES

The IL-8, and GRO-α chemokine inhibitory effects of compounds of the present invention are determined by the following *in vitro* assay:

Receptor Binding Assays:

[^{125}I] IL-8 (human recombinant) is obtained from Amersham Corp., Arlington Heights, IL, with specific activity 2000 Ci/mmol. GRO-α is obtained from NEN- New England Nuclear. All other chemicals are of analytical grade. High levels of recombinant human IL-8 type α and β receptors were individually expressed in Chinese hamster ovary cells as described previously (Holmes, *et al.*, Science, 1991, *253*, 1278). The Chinese hamster ovary membranes were homogenized according to a previously described protocol (Haour, *et al.*, J. Biol. Chem., 249 pp 2195-2205 (1974)). Except that the homogenization buffer is changed to 10mM Tris-HCL, 1mM $MgSO_4$, 0.5mM EDTA (ethylene-diaminetetra-acetic acid), 1mM PMSF (α-toluenesulphonyl fluoride), 0.5 mg/L Leupeptin, pH 7.5. Membrane protein concentration is determined using Pierce Co. micro-assay kit using bovine serum albumin as a standard. All assays are performed in a 96-well micro plate format. Each reaction mixture contains ^{125}I IL-8 (0.25 nM) or ^{125}I GRO-α and 0.5 μg/mL of IL-8Rα or 1.0 μg/mL of IL-8Rβ membranes in 20 mM Bis-Trispropane and 0.4 mM Tris HCl buffers, pH 8.0, containing 1.2 mM $MgSO_4$, 0.1 mM EDTA, 25 mM Na and 0.03% CHAPS. In addition, drug or compound of interest is added which has been pre-dissolved in DMSO so as to reach a final concentration of between 0.01nM and 100 uM. The assay is initiated by addition of ^{125}I-IL-8. After 1 hour at room temperature the plate is harvested using a Tomtec 96-well harvester onto a glass fiber filtermat blocked with 1% polyethylenimine/ 0.5% BSA and washed 3 times with 25 mM NaCl, 10 mM TrisHCl, 1 mM $MgSO_4$, 0.5 mM EDTA, 0.03 % CHAPS, pH 7.4. The filter is then dried and counted on the Betaplate liquid scintillation counter. The recombinant IL-8 Rα, or Type I, receptor is also referred to herein as the non-permissive receptor and the recombinant IL-8 Rβ, or Type II, receptor is referred to as the permissive receptor.

Representative compounds of Formula (I), Examples 1 to 106 have exhibited positive inhibitory activity in this assay at IC_{50} levels < 30 uM.

Chemotaxis Assay :

The *in vitro* inhibitory properties of these compounds are determined in the neutrophil chemotaxis assay as described in Current Protocols in Immunology, vol. I, Suppl 1, Unit 6.12.3., whose disclosure is incorporated herein by reference in its entirety. Neutrophils where isolated from human blood as described in Current Protocols in Immunology Vol. I, Suppl 1 Unit 7.23.1, whose disclosure is incorporated herein by reference in its entirety. The chemoattractants IL-8, GRO-α, GRO-β, GRO-γ and NAP-2 are placed in the bottom chamber of a 48 multiwell chamber (Neuro Probe, Cabin John, MD) at a concentration between 0.1 and 100 nM. The two chambers are separated by a 5 uM polycarbonate filter. When compounds of this invention are tested, they are mixed with the cells (0.001 - 1000 nM) just prior to the addition of the cells to the upper chamber. Incubation is allowed to proceed for between about 45 and 90 min at about 37°C in a humidified incubator with 5% CO_2. At the end of the incubation period, the polycarbonate membrane is removed and the top side washed, the membrane then stained using the Diff Quick staining protocol (Baxter Products, McGaw Park, IL, USA). Cells which have chemotaxed to the chemokine are visually counted using a microscope. Generally, four fields are counted for each sample, these numbers are averaged to give the average number of cells which had migrated. Each sample is tested in triplicate and each compound repeated at least four times. To certain cells (positive control cells) no compound is added, these cells represent the maximum chemotactic response of the cells. In the case where a negative control (unstimulated) is desired, no chemokine is added to the bottom chamber. The difference between the positive control and the negative control represents the chemotactic activity of the cells.

Elastase Release Assay:

The compounds of this invention are tested for their ability to prevent Elastase release from human neutrophils. Neutrophils are isolated from human blood as described in Current Protocols in Immunology Vol. I, Suppl 1 Unit 7.23.1. PMNs 0.88 x 10^6 cells suspended in Ringer's Solution (NaCl 118, KCl 4.56, $NaHCO_3$ 25, KH_2PO_4 1.03, Glucose 11.1, HEPES 5 mM, pH 7.4) are placed in each well of a 96 well plate in a volume of 50 ul. To this plate is added the test compound (0.001 - 1000 nM) in a volume of 50 ul, Cytochalasin B in a volume of 50 ul (20ug/ml) and Ringers buffer in a volume of 50 ul. These cells are allowed to warm (37 °C, 5% CO2, 95% RH) for 5 min before IL-8, GROα, GROβ, GROγ or NAP-2 at a final concentration of 0.01 - 1000 nM was added. The reaction is allowed to proceed for 45 min before the 96 well plate is centrifuged (800 xg 5 min.) and 100 ul of the supernatant removed. This supernatant is added to a second 96 well plate

followed by an artificial elastase substrate (MeOSuc-Ala-Ala-Pro-Val-AMC, Nova Biochem, La Jolla, CA) to a final concentration of 6 ug/ml dissolved in phosphate buffered saline. Immediately, the plate is placed in a fluorescent 96 well plate reader (Cytofluor 2350, Millipore, Bedford, MA) and data collected at 3 min intervals according to the method of Nakajima et al J. Biol. Chem. 254 4027 (1979). The amount of Elastase released from the PMNs is calculated by measuring the rate of MeOSuc-Ala-Ala-Pro-Val-AMC degradation.

TNF-α in Traumatic Brain Injury Assay

The present assay provides for examination of the expression of tumor necrosis factor mRNA in specific brain regions, which follow experimentally, induced lateral fluid-percussion traumatic brain injury (TBI) in rats. Adult Sprague-Dawley rats (n=42) were anesthetized with sodium pentobarbital (60 mg/kg, i.p.) and subjected to lateral fluid-percussion brain injury of moderate severity (2.4 atm.) centered over the left temporaparietal cortex (n=18), or "sham" treatment (anesthesia and surgery without injury, n=18). Animals are sacrificed by decapitation at 1, 6 and 24 hr. post injury, brains removed, and tissue samples of left (injured) parietal cortex (LC), corresponding area in the contralateral right cortex (RC), cortex adjacent to injured parietal cortex (LA), corresponding adjacent area in the right cortex (RA), left hippocampus (LH) and right hippocampus (RH) are prepared. Total RNA are isolated and Northern blot hybridization is performed and quantitated relative to an TNF-α positive control RNA (macrophage = 100%). A marked increase of TNF- α mRNA expression is observed in LH (104±17% of positive control, $p < 0.05$ compared with sham), LC (105±21%, $p < 0.05$) and LA (69±8%, $p < 0.01$) in the traumatized hemisphere 1 hr. following injury. An increased TNF- α mRNA expression is also observed in LH (46±8%, $p < 0.05$), LC (30±3%, $p < 0.01$) and LA (32±3%, $p < 0.01$) at 6 hr which resolves by 24 hr following injury. In the contralateral hemisphere, expression of TNF- α mRNA is increased in RH (46±2%, $p < 0.01$), RC (4±3%) and RA (22±8%) at 1 hr and in RH (28±11%), RC (7±5%) and RA (26±6%, $p < 0.05$) at 6 hr but not at 24 hr following injury. In sham (surgery without injury) or naive animals, no consistent changes in expression of TNF- α mRNA are observed in any of the 6 brain areas in either hemisphere at any times. These results indicate that following parasagittal fluid-percussion brain injury, the temporal expression of TNF-α mRNA is altered in specific brain regions, including those of the non-traumatized hemisphere. Since TNF-α is able to induce nerve growth factor (NGF) and stimulate the release of other cytokines from activated astrocytes, this post-traumatic alteration in gene expression of TNF-α plays an important role in both the acute and regenerative response to CNS trauma.

CNS Injury model for IL-1β mRNA

This assay characterizes the regional expression of interleukin-1ß (IL-1ß) mRNA in specific brain regions following experimental lateral fluid-percussion traumatic brain injury (TBI) in rats. Adult Sprague-Dawley rats (n=42) are anesthetized with sodium pentobarbital (60 mg/kg, i.p.) and subjected to lateral fluid-percussion brain injury of

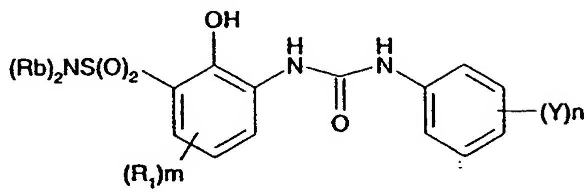
moderate severity (2.4 atm.) centered over the left temporaparietal cortex (n=18), or "sham" treatment (anesthesia and surgery without injury). Animals are sacrificed at 1, 6 and 24 hr. post injury, brains removed, and tissue samples of left (injured) parietal cortex (LC), corresponding area in the contralateral right cortex (RC), cortex adjacent to injured parietal cortex (LA), corresponding adjacent area in the right cortex (RA), left hippocampus (LH) and right hippocampus (RH) are prepared. Total RNA is isolated and Northern blot hybridization was performed and the quantity of brain tissue IL-1ß mRNA is presented as percent relative radioactivity of IL-1ß positive macrophage RNA which was loaded on the same gel. At 1 hr following brain injury, a marked and significant increase in expression of IL-1ß mRNA is observed in LC (20.0±0.7% of positive control, n=6, $p < 0.05$ compared with sham animal), LH (24.5±0.9%, $p < 0.05$) and LA (21.5±3.1%, $p < 0.05$) in the injured hemisphere, which remained elevated up to 6 hr. post injury in the LC (4.0±0.4%, n=6, $p < 0.05$) and LH (5.0±1.3%, $p < 0.05$). In sham or naive animals, no expression of IL-1ß mRNA is observed in any of the respective brain areas. These results indicate that following TBI, the temporal expression of IL-1ß mRNA is regionally stimulated in specific brain regions. These regional changes in cytokines, such as IL-1ß play a role in the post-traumatic.

All publications, including but not limited to patents and patent applications, cited in this specification are herein incorporated by reference as if each individual publication were specifically and individually indicated to be incorporated by reference herein as though fully set forth.

The above description fully discloses the invention including preferred embodiments thereof. Modifications and improvements of the embodiments specifically disclosed herein are within the scope of the following claims. Without further elaboration, it is believed that one skilled in the art can, using the preceding description, utilize the present invention to its fullest extent. Therefore the Examples herein are to be construed as merely illustrative and not a limitation of the scope of the present invention in any way. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows.

What is Claimed Is:

1. A compound of the formula (I):



(I)

wherein

R_b is independently hydrogen, NR_6R_7, OH, OR_a, C_{1-5}alkyl, aryl, arylC_{1-4}alkyl, aryl C_{2-4}alkenyl; cycloalkyl, cycloalkyl C_{1-5} alkyl, heteroaryl, heteroarylC_{1-4}alkyl, heteroarylC_{2-4} alkenyl, heterocyclic, heterocyclic C_{1-4}alkyl, or a heterocyclic C_{2-4}alkenyl moiety, all of which moieties may be optionally substituted one to three times independently by halogen; nitro; halosubstituted C_{1-4} alkyl; C_{1-4} alkyl; amino, mono or di-C_{1-4} alkyl substituted amine; OR_a; $C(O)R_a$; $NR_aC(O)OR_a$; $OC(O)NR_6R_7$; hydroxy; $NR_9C(O)R_a$; $S(O)_{m'}R_a$; $C(O)NR_6R_7$; C(O)OH; $C(O)OR_a$; $S(O)_tNR_6R_7$; $NHS(O)_tR_a$; or the two R_b substituents join to form a 3-10 membered ring, optionally substituted and containing, in addition to optionally substituted C_{1-4} alkyl, independently, 1 to 3 NR_a, O, S, SO, or SO_2 moities which can be optionally unsaturated;

R_a is an alkyl, aryl, arylC_{1-4}alkyl, heteroaryl, heteroaryl C_{1-4}alkyl, heterocyclic, $COOR_a'$, or a heterocyclic C_{1-4}alkyl moiety, all of which moieties may be optionally substituted;

R_a' is an alkyl, aryl, arylC_{1-4}alkyl, heteroaryl, heteroaryl C_{1-4}alkyl, heterocyclic or a heterocyclic C_{1-4}alkyl moiety, all of which moieties may be optionally substituted;

m is an integer having a value of 1 to 3;

m' is 0, or an integer having a value of 1 or 2;

n is an integer having a value of 1 to 3;

q is 0, or an integer having a value of 1 to 10;

t is 0, or an integer having a value of 1 or 2;

s is an integer having a value of 1 to 3;

R_1 is independently selected from hydrogen, halogen, nitro, cyano, C_{1-10} alkyl, halosubstituted C_{1-10} alkyl, C_{2-10} alkenyl, C_{1-10} alkoxy, halosubstituted C_{1-10}alkoxy, azide, $S(O)_tR_4$, $(CR_8R_8)_q\ S(O)_tR_4$, hydroxy, hydroxy substituted C_{1-4}alkyl, aryl, aryl C_{1-4} alkyl, aryl C_{2-10} alkenyl, aryloxy, aryl C_{1-4} alkyloxy, heteroaryl, heteroarylalkyl, heteroaryl C_{2-10} alkenyl, heteroaryl C_{1-4} alkyloxy, heterocyclic, heterocyclic C_{1-4}alkyl, heterocyclicC_{1-4}alkyloxy,

heterocyclicC_{2-10} alkenyl, $(CR_8R_8)q$ NR_4R_5, $(CR_8R_8)qC(O)NR_4R_5$, C_{2-10} alkenyl $C(O)NR_4R_5$, $(CR_8R_8)q$ $C(O)NR_4R_{10}$, $S(O)_3R_8$, $(CR_8R_8)q$ $C(O)R_{11}$, C_{2-10} alkenyl $C(O)R_{11}$, C_{2-10} alkenyl $C(O)OR_{11}$, $(CR_8R_8)q$ $C(O)OR_{11}$, $(CR_8R_8)q$ $OC(O)R_{11}$, $(CR_8R_8)qNR_4C(O)R_{11}$, $(CR_8R_8)q$ $C(NR_4)NR_4R_5$, $(CR_8R_8)q$ $NR_4C(NR_5)R_{11}$, $(CR_8R_8)q$ $NHS(O)_tR_{13}$, $(CR_8R_8)q$ $S(O)_tNR_4R_5$, or two R_1 moieties together may form $O-(CH_2)_sO$ or a 5 to 6 membered saturated or unsaturated ring, and wherein the alkyl, aryl, arylalkyl, heteroaryl, heterocyclic moieties may be optionally substituted;

R_4 and R_5 are independently hydrogen, optionally substituted C_{1-4} alkyl, optionally substituted aryl, optionally substituted aryl C_{1-4}alkyl, optionally substituted heteroaryl, optionally substituted heteroaryl C_{1-4}alkyl, heterocyclic, heterocyclicC_{1-4} alkyl, or R_4 and R_5 together with the nitrogen to which they are attached form a 5 to 7 member ring which may optionally comprise an additional heteroatom selected from O, N and S;

R_6 and R_7 are independently hydrogen, or a C_{1-4} alkyl, heteroaryl, aryl, aklyl aryl, alkyl C_{1-4} heteroalkyl, which may all be optionally substituted or R_6 and R_7 together with the nitrogen to which they are attached form a 5 to 7 member ring which ring may optionally contain an additional heteroatom is selected from oxygen, nitrogen or sulfur, and which ring may be optionally substituted;

Y is hydrogen, halogen, nitro, cyano, halosubstituted C_{1-10} alkyl, C_{1-10} alkyl, C_{2-10} alkenyl, C_{1-10} alkoxy, halosubstituted C_{1-10} alkoxy, azide, $(CR_8R_8)qS(O)_tR_a$, $(CR_8R_8)qOR_a$, hydroxy, hydroxy substituted C_{1-4}alkyl, aryl; aryl C_{1-4} alkyl, aryloxy, arylC_{1-4} alkyloxy, aryl C_{2-10} alkenyl, heteroaryl, heteroarylalkyl, heteroaryl C_{1-4} alkyloxy, heteroaryl C_{2-10} alkenyl, heterocyclic, heterocyclic C_{1-4}alkyl, heterocyclicC_{2-10} alkenyl, $(CR_8R_8)qNR_4R_5$, C_{2-10} alkenyl $C(O)NR_4R_5$, $(CR_8R_8)qC(O)NR_4R_5$, $(CR_8R_8)q$ $C(O)NR_4R_{10}$, $S(O)_3R_8$, $(CR_8R_8)qC(O)R_{11}$, C_{2-10} alkenyl$C(O)R_{11}$, $(CR_8R_8)qC(O)OR_{11}$, C_{2-10}alkenyl$C(O)OR_{11}$, $(CR_8R_8)qOC(O)R_{11}$, $(CR_8R_8)qNR_4C(O)R_{11}$, $(CR_8R_8)q$ $NHS(O)_tR_{13}$, $(CR_8R_8)q$ $S(O)_tNR_4R_5$, $(CR_8R_8)qC(NR_4)NR_4R_5$, $(CR_8R_8)q$ $NR_4C(NR_5)R_{11}$, or two Y moieties together may form $O-(CH_2)_s-O$ or a 5 to 6 membered saturated or unsaturated ring, and wherein the alkyl, aryl, arylalkyl, heteroaryl, heteroaryl alkyl, heterocyclic, heterocyclicalkyl groups may be optionally substituted;

R_8 is hydrogen or C_{1-4} alkyl;

R_9 is hydrogen or a C_{1-4} alkyl;

R_{10} is C_{1-10} alkyl $C(O)_2R_8$;

R_{11} is hydrogen, optionally substituted C_{1-4} alkyl, optionally substituted aryl, optionally substituted aryl C_{1-4}alkyl, optionally substituted heteroaryl, optionally substituted heteroarylC_{1-4}alkyl, optionally substituted heterocyclic, or optionally substituted heterocyclicC_{1-4}alkyl;

R_{13} is suitably C_{1-4} alkyl, aryl, aryl C_{1-4}alkyl, heteroaryl, heteroarylC_{1-4}alkyl, heterocyclic, or heterocyclicC_{1-4}alkyl;
or a pharmaceutically acceptable salt thereof.

2. The compound according to Claim 1 wherein R_1 is substituted in the 4- position by an electron withdrawing moiety.

3. The compound according to Claim 2 wherein R_1 is halogen, cyano or nitro.

4. The compound according to Claim 3 wherein R_1 is halogen.

5. The compound according to Claim 4 wherein R_1 is independently, fluorine, chlorine, or bromine.

6. The compound according to Claim 1 wherein Y is mono-substituted in the 2'-position or 3'- position, or is disubstituted in the 2'- or 3'- position of a monocyclic ring.

7. The compound according to Claim 6 wherein Y is halogen.

8. The compound according to Claim 4 wherein Y is independently fluorine, chlorine, or bromine.

9. The compound according to Claim 1 wherein R_b is hydrogen, C_{1-4} alkyl, or C_{1-4} alkyl substituted with C(O)OH, or C(O)OR_a.

10. The compound according to Claim 1 wherein Y is halogen, n is 1 or 2, R_1 is halogen, m is 1 or 2, and R_b is, independently, hydrogen, C_{1-4} alkyl, C_{1-4} alkyl substituted with C(O)OH, or C(O)ORa.

11. The compound according to Claim 1 which isselected from the group consisting of:
N-(2-Hydroxyl-3-aminosulfonyl-4-chlorophenyl)-N'-(2-bromophenyl) urea;
N-(2-Hydroxy-3-aminosulfonyl-4-chlorophenyl)-N'-(2,3-dichlorophenyl) urea;
N-(2-Hydroxy-3-N"-benzylaminosulfonyl-4-chlorophenyl)-N'-(2-bromophenyl) urea;
N-(2-Hydroxy-3-N"-benzylaminosulfonyl-4-chlorophenyl)-N'-(2,3-dichlorophenyl) urea;
N-[2-Hydroxy-3-(N",N"-dimethyl)-aminosulfonyl-4-chlorophenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-Hydroxy-3-N",N"-dimethylaminosulfonyl-4-chlorophenyl)-N'-(2-bromophenyl) urea;

N-(2-Hydroxy-3-N"-methylaminosulfonyl-4-chlorophenyl)-N'-(2-bromophenyl) urea;
N-(2-Hydroxy-3-N"-methylaminosulfonyl-4-chlorophenyl)-N'-(2,3-dichlorophenyl) urea;
N-[2-Hydroxy-3-[N-(methoxycarbonylmethyl)aminosulfonyl]-4-chlorophenyl]-N'-(2,3-dichlorophenyl) urea;
N-[2-Hydroxy-3-(N"-(2-methoxylcarbonyl)-methyl)-aminosulfonyl-4-chlorophenyl]-N'-(2-bromophenyl) urea;
N-[2-Hydroxy-3-[(N"-2-carboxymethyl)-aminosulfonyl]-4-chlorophenyl]-N'-(2,3-dichlorophenyl) urea;
N-[2-Hydroxy-3-(N"-2-carboxymethyl)-aminosulfonyl-4-chlorophenyl]-N'-(2-bromophenyl) urea;
N-[2-Hydroxy-3-aminosulfonyl-4-chlorophenyl]-N'-(2-chlorophenyl) urea;
N-[2-Hydroxy-3-aminosulfonyl-4-chlorophenyl]-N'-phenyl urea;
N-(2-Hydroxy-3-aminosulfonyl-4-chlorophenyl)-N'-(2-phenoxyphenyl) urea;
N-(2-Hydroxy-3-[N"-(3-carboxyethyl)-aminosulfonyl]-4-chlorophenyl)-N'-(2-bromophenyl) urea;
N-[2-Hydroxy-3-(isopropylaminosulfonyl)-4-chlorophenyl]-N'-(2-bromophenyl) urea;
N-[2-Hydroxy-3-(isopropylaminosulfonyl)-4-chlorophenyl]-N'-(2-chlorophenyl) urea;
N-[2-Hydroxy-3-(isopropylaminosulfonyl)-4-chlorophenyl]-N'-(2,3-dichlorophenyl) urea;
N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2-methoxyphenyl) urea;
N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-methylenedioxy phenyl) urea;
N-(2-benzyloxyphenyl)-N'-(4-chloro-2-hydroxy-3-aminosulfonylphenyl) urea;
N-[3-(N"-allylaminosulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;
N-[4-chloro-2-hydroxy-3-[N"-(2-trifluoroethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2,3-dichlorophenyl)-N'-[2-hydroxy-4-methoxy-3-N"-(phenylaminosulfonyl)phenyl] urea;
N-(2-bromophenyl)-N'-[2-hydroxy-4-methoxy-3-N"-(phenylaminosulfonyl)phenyl] urea;
N-[4-chloro-2-hydroxy-3-[N"-(2-methoxyethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(2-methoxyethyl)aminosulfonyl]phenyl] urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(4-morpholinylsulfonyl)phenyl] urea;
N-[4-chloro-2-hydroxy-3-(4-morpholinylsulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea;
N-[3-[N"-[3-(tert-butoxycarbonylamino)propyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[3-[N"-[3-(tert-butoxycarbonylamino)propyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea;

N-[3-[N"-(3-aminopropyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea trifluoroacetate;

N-[3-[N"-(3-aminopropyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea hydrochloride;

N-[3-[N"-(3-aminopropyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate;

N-(2-bromophenyl)-N'-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea;

N-[3-[N"-(2-aminoethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea;

N-(2-bromophenyl)-N'-[3-[[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl]-4-chloro-2-hydroxyphenyl] urea;

N-[3-[[4-(tert-butoxycarbonyl)piperazin-1-yl]sulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;

N-[4-chloro-2-hydroxy-3-(1-piperazinylsulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(piperazin-1-ylsulfonyl)phenyl] urea trifluoroacetate;

N-[4-chloro-2-hydroxy-3-[N"-(3-methylthiopropyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(3-methylthiopropyl)aminosulfonyl]phenyl] urea;

N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea potasium salt;

N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea sodium salt;

N-(2-bromophenyl)-N'-[4-chloro-3-[N",N"-di-(2-methoxyethyl)aminosulfonyl]-2-hydroxyphenyl] urea;

N-[4-chloro-3-[N",N"-di-(2-methoxyethyl)aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-3-[N"-[2-(dimethylamino)ethyl]aminosulfonyl]-2-hydroxyphenyl] urea hydrochloride;

N-[4-chloro-3-[N"-[2-(dimethylamino)ethyl]aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride;

N-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfonyl)propyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfonyl)propyl]aminosulfonyl]phenyl] urea;

N-[4-chloro-2-hydroxy-3-[N"-[2-(morpholinyl)ethyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride;

N-[4-chloro-2-hydroxy-3-[N"-[2-(morpholinyl)ethyl]aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea hydrochloride;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[2-(4-morpholinyl)ethyl]aminosulfonyl]phenyl] urea;

N-[4-chloro-2-hydroxy-3-(4-thiomorpholinylsulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(4-thiomorpholinylsulfonyl)phenyl] urea;

N-(2-bromophenyl)-N'-[4-chloro-3-[N",N"-di-(2-hydroxyethyl)aminosulfonyl]-2-hydroxyphenyl] urea;

N-[4-chloro-3-[N",N"-di-(2-hydroxyethyl)aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea,

N-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfinyl)propyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[3-(methylsulfinyl)propyl]aminosulfonyl]phenyl] urea;

N-(2-bromophenyl)-N'-[3-[N"-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea,

N-[3-[N"-[(1-tert-butoxycarbonylpiperidin-4-yl)methyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;

N-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl] urea;

N-[4-chloro-2-hydroxy-3-[N"-[(piperidin-4-yl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea trifluroacetate;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[(piperidin-4-yl)methyl]aminosulfonyl]phenyl] urea hydrochloride;

N-[3-(1-azetidinylsulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea;

N-[3-(1-azetidinylsulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea;

N-[3-(1-azetidinylsulfonyl)-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-3-(N",N"-dimethylaminosulfonyl)-2-hydroxyphenyl] urea potassium salt;

N-(2-bromophenyl)-N'-[4-chloro-3-(N",N"-dimethylaminosulfonyl)-2-hydroxyphenyl] urea sodium salt;
N-(2-bromophenyl)-N'-[4-chloro-3-(N"-cyclopropylaminosulfonyl)-2-hydroxyphenyl) urea;
N-[4-chloro-3-(N"-cyclopropylaminosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea;
N-[4-chloro-3-(N"-cyclopropylaminosulfonyl)-2-hydroxphenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-propylaminosulfonyl)phenyl] urea;
N-[4-chloro-2-hydroxyl-3-(N"-propylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea;
N-[4-chloro-2-hydroxyl-3-(N"-propylaminosulfonyl)phenyl]-N'-(2-chlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-3-(N"-ethylaminosulfonyl])-2-hydroxyphenyl] urea;
N-[4-chloro-3-(N"-ethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea;
N-[4-chloro-3-(N"-ethylaminosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxylpentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea;
N-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxylpentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;
N-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxylpentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(2-hydroxyethyl)aminosulfonyl] urea;
N-(2,3-dichlorophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-(2-hydroxyethyl)aminosulfonyl] urea;
N-(2-bromophenyl)-N'-[3-[N"-[[(2-bromophenylamino)carboxyl]ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea;
N-[3-[N"-(2-benzyloxyethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2 bromophenyl) urea;
N-[2-Hydroxy-3-(N"-cyclopropylmethylaminosulfonyl)-4-chlorophenyl]-N'-(2,3-dichlorophenyl) urea;
N-[2-Hydroxy-3-(N"-cyclopropylmethylaminosulfonyl)-4-chlorophenyl]-N'-(2 chlorophenyl) urea;
N-[2-Hydroxy-3-(N"-cyclopropylmethylaminosulfonyl)-4-chlorophenyl]-N'-(2 bromophenyl) urea;
N-[2-Hydroxy-3-(N"-methoxy-N"-methylaminosulfonyl)-4-chlorophenyl]-N'-(2-bromophenyl) urea;
N-[2-Hydroxy-3-(N"-methoxy-N"-methylaminosulfonyl)-4-chlorophenyl]-N'-(2 chlorophenyl) urea;
N-[2-Hydroxy-3-(N"-methoxy-N"-methylaminosulfonyl)-4-chlorophenyl]-N'-(2,3 dichlorophenyl) urea;

N-[2-Hydroxy-3-(N"-pyrrolidinylsulfonyl)-4-chlorophenyl]-N'-(2,3-dichlorophenyl) urea;
N-[2-Hydroxy-3-(N"-pyrrolidinylsulfonyl)-4-chlorophenyl]-N'-(2-bromophenyl) urea;
N-[2-Hydroxy-3-(N"-pyrrolidinylsulfonyl)-4-chlorophenyl]-N'-(2-chlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(4-pyridinylaminosulfonyl]phenyl] urea;
N-[4-chloro-2-hydroxy-3-[(4-pyridinylaminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[[[2-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] urea;
N-[4-chloro-2-hydroxy-3-[[[2-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] -N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[[[(2R)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] urea; and
N-[4-chloro-2-hydroxy-3-[[[(2R)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[[[(2S)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl] urea;
N-[4-chloro-2-hydroxy-3-[[[(2S)-(tetrahydro-2-furanyl)methyl]aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-cyclopentylaminosulfonyl)phenyl]urea;
N-[4-chloro-2-hydroxy-3-(N"-cyclopentylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea;
N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-cyclopentylaminosulfonyl)phenyl]urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl) phenyl]urea;
N-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea;
N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl) phenyl]urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-(N"-tetrahydroisoxazylaminosulfonyl) phenyl]urea;
N-[4-chloro-2-hydroxy-3-(N"-tetrahydroisoxazylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea;
N-(2-chlorophenyl)-N'-[4-chloro-2-hydroxy-3-N"-(tetrahydroisoxazylaminosulfonyl) phenyl]urea;
N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl)aminosulfonyl]phenyl] urea;

N-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;

N-[4-chloro-2-hydroxy-3-[(2-isopropoxyethyl)aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(2-ethoxyethyl)aminosulfonyl]phenyl] urea;

N-[4-chloro-2-hydroxy-3-[(2-ethoxyethyl)aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;

N-[4-chloro-2-hydroxy-3-[(2-ethoxyethyl)aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[(2-methoxycarbonyl)azetidin-1-yl]sulfonylphenyl] urea;

N-[4-chloro-2-hydroxy-3-[(2-methoxycarbonyl)azetidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea;

N-[4-chloro-2-hydroxy-3-[(2-carboxy)-azetidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[N"-[3-(4-morpholinyl)propyl]aminosulfonyl]phenyl] urea hydrochloride;

N-[4-chloro-2-hydroxy-3-[N"-[3-(4-morpholinyl)propyl]-aminosulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride;

N-[4-chloro-2-hydroxy-3-[N"-[3-(4-morpholinyl)propyl]aminosulfonyl]phenyl]-N'-(2-chlorophenyl) urea hydrochloride;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylphenyl] urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(-)-(2-hydroxymethyl)pyrrolidin-1-yl]sulfonylphenyl] urea;

N-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea;

N-[4-chloro-2-hydroxy-3-[S-(-)-(2-hydroxymethyl)-pyrrolidin-1-ylsulfonyl]phenyl]-N'-(2,3-dichlorophenyl) urea;

N-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)-pyrrolidin-1-yl]sulfonylphenyl]-N'-(2-chlorophenyl) urea;

N-[4-chloro-2-hydroxy-3-[S-(-)-(2-hydroxymethyl)-pyrrolidin-1-yl]sulfonylphenyl]-N'-(2-chlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(2-methoxycarbonyl)pyrrolidin-1-yl]sulfonylphenyl] urea;

N-(2-bromophenyl)-N'-[4-chloro-2-hydroxy-3-[S-(2-carboxy)pyrrolidin-1-yl]sulfonylphenyl] urea;

N-(2-bromophenyl)-N'-[3-[N"-(tert-butyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl] urea;

N-[3-[N"-(tert-butyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;

N-[3-[N"-(tert-butyl)aminosulfonyl]-4-chloro-2-hydroxylphenyl]-N'-(2-chlorophenyl) urea;

N-[3-[N"-[5-(tert-butoxycarbonylamino)-5-carboxypentyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea;

N-[3-[N"-(5-amino-5-carboxypentyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea hydrochloride;

N-[3-[N"-(5-amino-5-carboxypentyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea hydrochloride;

N-[3-[N"-(5-amino-5-carboxypentyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-bromophenyl) urea hydrochloride;

N-[4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyphenyl] urea;

N-[4-chloro-3-(1,1-dioxidothiomorpholinosulfonyl)-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea;

N-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea;

N-[3-[N"-(2-aminoethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea trifluoroacetate;

N-[3-[N"-[2-(tert-butoxycarbonylamino)ethyl]aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea;

N-[3-[N"-(2-aminoethyl)aminosulfonyl]-4-chloro-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea trifluoroacetate;

N-[4-chloro-2-hydroxy-3- (N",N"-dimethylaminosulfonyl)phenyl]-N'-(2-chlorophenyl) urea.;

N-[4-chloro-2-hydroxy-3-(aminosulfonyl)phenyl]-N'-(2-bromo-3-fluorophenyl) urea;

N-[4-chloro-2-hydroxy-3-(aminosulfonyl)phenyl]-N'-(2-chloro-3-fluorophenyl) urea;

N-(2-bromophenyl)-N'-[4-chloro-3-[(1-ethyl-pyrrolidin-2-yl)methylaminosulfonyl]-2-hydroxyphenyl] urea hydrochloride ;

N-[4-chloro-3-[(1-ethyl-pyrrolidin-2-yl)methylaminosulfonyl]-2-hydroxyphenyl] N'-(2,3-dichlorophenyl) urea hydrochloride; and

N-[4-chloro-3-[(1-ethyl-pyrrolidin-2-yl)methylaminosulfonyl]-2-hydroxyphenyl]-N'-(2-chlorophenyl) urea hydrochloride;

or a pharmaceutically acceptable salt thereof.

or a pharmaceutically acceptable salt thereof.

12. A compound according to claim 11 which is selected from the group consisting of :
N-(4-chloro-2-hydroxy-3-aminosulfonylphenyl)-N'-(2,3-dichlorophenyl) urea;
N-[4-chloro-2-hydroxy-3-[S-(-)-(2-methoxymethyl)pyrrolidin-1-yl]sulfonylphenyl]-N'-(2,3-dichlorophenyl) urea;
N-[4-chloro-2-hydroxy-3-(N"-isoxazolidinylaminosulfonyl)phenyl]-N'-(2,3-dichlorophenyl)urea;
N-[4-chloro-2-hydroxy-3-(1-oxidothiomorpholinosulfonyl)phenyl]-N'-(2,3-dichlorophenyl) urea; and
N-[4-chloro-3-[N",N"-di-(2-methoxyethyl)aminosulfonyl]-2-hydroxyphenyl]-N'-(2,3-dichlorophenyl) urea.

13. A compound according to claim 12 wherein the compoundis in its sodium salt form.

14. A compound according to claim 13 wherein the compound is in its potassium salt form.

15. A pharmaceutical composition comprising a compound according to any of Claims 1 to 14 and a pharmaceutically acceptable carrier or diluent.

16. A method of treating a chemokine mediated disease, wherein the chemokine binds to an IL-8 a or b receptor in a mammal, which method comprises administering to said mammal an effective amount of a compound of the formula according to any one of Claims 1 to 14.

17. The method according to Claim 16 wherein the mammal is afflicted with a chemokine mediated disease selected from atopic dermatitis, osteo arthritis, rheumatoid arthritis, asthma, chronic obstructive pulmonary disease, adult respiratory distress syndrome, inflammatory bowel disease, Crohn's disease, ulcerative colitis, stroke, septic shock, multiple sclerosis, endotoxic shock, psoriasis, gram negative sepsis, toxic shock syndrome, cardiac and renal reperfusion injury, glomerulonephritis, thrombosis, graft vs. host reaction, alzheimers disease, allograft rejections, malaria, restinosis, angiogenesis, atherosclerosis, osteoporosis, gingivitis and undesired hematopoietic stem cells release, diseases caused by respiratory viruses, herpesviruses, and hepatitis viruses, meningitis, herpes encephalitis, CNS vasculitis, traumatic brain injury, CNS tumors, subarachnoid hemorrhage, post surgical trauma, cystic fibrosis, pre-term labour, cough, pruritus, interstitial pneumonitis, hypersensitivity, crystal induced arthritis, lyme arthritis, fibrodysplasia ossificans progressiva, acute and chronic pancreatitis, acute alcoholic hepatitis, necrotizing enterocolitis, chronic sinusitis, uveitis, polymyositis, vasculitis, acne, gastric and duodenal ulcers, celiac disease, esophagitis, glossitis, airflow obstruction, airway hyperresponsiveness, bronchiolitis obliterans organizing pneumonia, bronchiectasis,

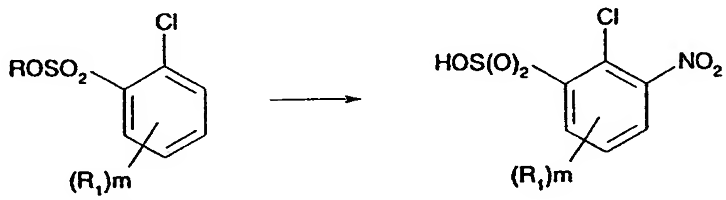
bronchiolitis, bronchiolitis obliterans, chronic bronchitis, cor pulmonae, dyspnea, emphysema, hypercapnea, hyperinflation, hypoxemia, hypoxia, surgerical lung volume reduction, pulmonary fibrosis, pulmonary hypertension, right ventricular hypertropy, sarcoidosis, small airway disease, ventilation-perfusion mismatching, wheeze and lupus.

18. A compound selected from the group consisting of formulas (II), (III), (IV), (V) and (VI) hereinbelow:

(V) (VI) (VII)

wherein R_1 is not hydrogen.

19. A method of converting a chloro compound of formula (VII) to a phenol of formula (III) by reacting with sodium acetate and 18-C-6 followed by hydrolysis with sulfuric acid and methanol.



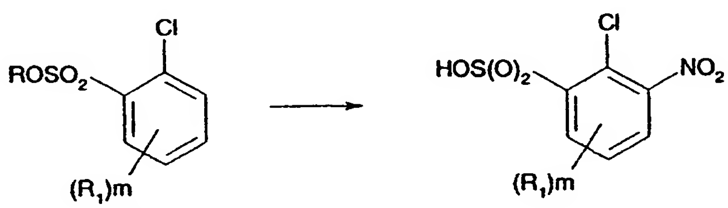
(VIII) (IX)

wherein R represents H or Na; and

R_1 is as in claim 1, above.

20. A method of converting a chloro compound of formula (VII) to a phenol of formula (III) by reacting to the chloro compound with sodium hydride and water in THF.

R = H or Na



(VIII) (IX)

wherein R represents H or Na and R_1 is as in claim 1, above.

21. A method of converting a compound of formula (VIII) to a nitro compound of formula (IX) by reacting the sulfonic acid compound with nitric acid in sulfuric acid

R = H or Na

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/29940

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :Please See Extra Sheet.
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 514/227.5, 227.8, 237.8, 317, 426, 596, 597; 544/1, 106, 108; 546/153, 194; 548/558; 564/32, 47, 48, 48, 50, 53, 54

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Database Caplus on STN, Chem Abstracts, (Columbus OH, USA) No. 128:110869, Widdowson, K. 'Phenyl urea interleukin-8 receptor antagonists for treatment of interleukin-8-mediated diseases and preparation thereof', abstract WO9749286, December 1997.	1-17
A	Database Caplus on STN, Chem Abstracts, (Columbus OH, USA) No. 128:110887, Widdowson, K. ' Phenylurea Il-8 receptor antagonists, preparation thereof and therapeutic use', abstract W09749400, December 1997.	1-17

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:
"A"	document defining the general state of the art which is not considered to be of particular relevance
"E"	earlier document published on or after the international filing date
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O"	document referring to an oral disclosure, use, exhibition or other means
"P"	document published prior to the international filing date but later than the priority date claimed
"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&"	document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 MARCH 2000	26 APR 2000

Name and mailing address of the ISA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	JEAN F VOLLANO
Facsimile No. (703) 305-3230	Telephone No. (703) 308-1235

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/29940

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Database Caplus on STN, Chem Abstracts, (Columbus OH, USA) No. 130:38286, Ranges, G. et al. 'Inhibition of p38 kinase activity by aryl ureas', abstract WO9852558, November 1998.	1-17
A	US 4,786,316 A (TSENG) 22 November 1988 (22.11.1988) see columns 17-72.	1-15
A	US 4,155,930 A (SIUTA et al) 22 May 1979 (22.5.79) see column 9, lines 27-42.	21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/29940

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 18-20
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Please See Extra Sheet.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/29940

A. CLASSIFICATION OF SUBJECT MATTER:
IPC (7):

A61K 31/ 17, 31/40, 31/54, 31/445, 31/535; C07C 273/00 275/00; C07D 207/10, 207/22, 207/34, 211/80, 215/16, 215/20, 215/36, 265/30, 295/00

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

514/227.5, 227.8, 237.8, 317, 426, 596, 597; 544/1, 106, 108; 546/153, 194; 548/558; 564/32, 47, 48, 48, 50, 53, 54

B. FIELDS SEARCHED
Electronic data bases consulted (Name of data base and where practicable terms used):

EAST, CAS ONLINE, BEILSTEIN

search terms: structure drawing, diphenyl urea, sulfonamide, hydroxyphenyl, phenol, chemokine, interleukin-8

BOX I. OBSERVATIONS WHERE CLAIMS WERE FOUND UNSEARCHABLE
2. Where no meaningful search could be carried out, specifically:

Claim 18 is drawn to compounds of formula (II), (III), (IV), (V) and (VI) that are stated in the claim to be "herein below:" However, in the below section of the claim there are only three brackets with roman numbers as shown here.
(VI) (VI) (VII)
There are no compounds given in the claim and it is also unclear why there is an addition roman numeral (VII) in the claim. Claims 19-20 are methods for preparing compounds of formula (III) from formula (VII). There is no formula (VII) or (III) defined in the claims.